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1922/23

The Bulletin of the University of Minnesota

*The Graduate School
Announcement for the Year
1922-1923*



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Scale of Feet

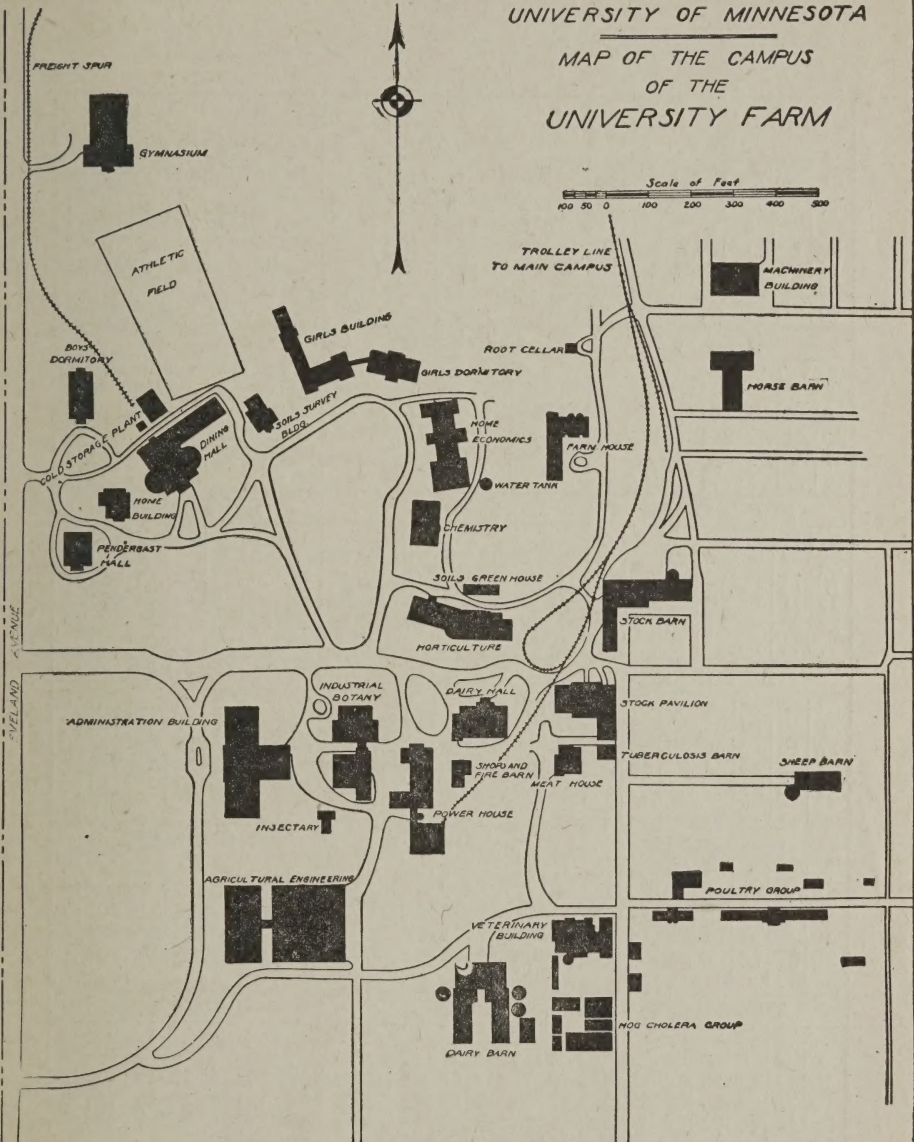
100 50 0 100 200 300 400 500
Y LINE
UNIVERSITY FARM



Area of Main Campus, 108.5 acres

UNIVERSITY OF MINNESOTA

MAP OF THE CAMPUS OF THE UNIVERSITY FARM



Area of University Farm, 422.56 acres

1922							1923													
JULY							JANUARY							JULY						
Su	Mo	Tu	W	Th	Fr	Sa	Su	Mo	Tu	W	Th	Fr	Sa	Su	Mo	Tu	W	Th	Fr	Sa
..	..	..	..	..	..	1	..	1	2	3	4	5	6	1	2	3	4	5	6	7
2	3	4	5	6	7	8	7	8	9	10	11	12	13	8	9	10	11	12	13	14
9	10	11	12	13	14	15	14	15	16	17	18	19	20	15	16	17	18	19	20	21
16	17	18	19	20	21	22	21	22	23	24	25	26	27	22	23	24	25	26	27	28
23	24	25	26	27	28	29	28	29	30	31	..	..	..	29	30	31	..	..	..	..
30	31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
AUGUST							FEBRUARY							AUGUST						
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6	7	8	9	10	11	12	4	5	6	7	8	9	10	5	6	7	8	9	10	11
13	14	15	16	17	18	19	11	12	13	14	15	16	17	12	13	14	15	16	17	18
20	21	22	23	24	25	26	18	19	20	21	22	23	24	19	20	21	22	23	24	25
27	28	29	30	31	..	..	25	26	27	28	..	..	..	26	27	28	29	30	31	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
SEPTEMBER							MARCH							SEPTEMBER						
..	3	4	5	..	7	8	4	5	6	7	1	2	3	..	2	3	4	5	6	7
10	11	12	13	14	15	16	11	12	13	14	15	16	17	9	10	11	12	13	14	15
17	18	19	20	21	22	23	18	19	20	21	22	23	24	16	17	18	19	20	21	22
24	25	26	27	28	29	30	25	26	27	28	29	30	31	23	24	25	26	27	28	29
..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	..	..	..	..	..	..
OCTOBER							APRIL							OCTOBER						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	..	1	2	3	4	5	6
8	9	10	11	12	13	14	8	9	10	11	12	13	14	7	8	9	10	11	12	13
15	16	17	18	19	20	21	15	16	17	18	19	20	21	14	15	16	17	18	19	20
22	23	24	25	26	27	28	22	23	24	25	26	27	28	21	22	23	24	25	26	27
29	30	31	..	..	..	..	29	30	..	..	..	..	..	28	29	30	31	..	..	..
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NOVEMBER							MAY							NOVEMBER						
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5	6	7	8	9	10	11	6	7	8	9	10	11	12	4	5	6	7	8	9	10
12	13	14	15	16	17	18	13	14	15	16	17	18	19	11	12	13	14	15	16	17
19	20	21	22	23	24	25	20	21	22	23	24	25	26	18	19	20	21	22	23	24
26	27	28	29	30	..	..	27	28	29	30	31	..	..	25	26	27	28	29	30	..
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DECEMBER							JUNE							DECEMBER						
..	..	..	..	..	1	2	..	..	..	..	1	2	..	..	..	..	..	..	1	..
3	4	5	6	7	8	9	3	4	5	6	7	8	9	2	3	4	5	6	7	8
10	11	12	13	14	15	16	10	11	12	13	14	15	16	9	10	11	12	13	14	15
17	18	19	20	21	22	23	17	18	19	20	21	22	23	16	17	18	19	20	21	22
24	25	26	27	28	29	30	24	25	26	27	28	29	30	23	24	25	26	27	28	29
31	..	..	..	..	..	..	..	..	..	..	..	..	..	30	31	..	..	..	..	..

UNIVERSITY CALENDAR

1922-23

1922

September 25-October 7			Registration of graduate students
			Physical examinations for all students
September	27	Wednesday	Fall quarter begins, 8:30* a.m.
October	12	Thursday	Examinations in German and French for candidates for all advanced degrees
November	7	Tuesday	Election Day; a holiday
November	11	Saturday	Armistice Day; a holiday
November	18	Saturday	Last day for filing subject-matter of Master's thesis
November	30	Thursday	Thanksgiving Day; a holiday
December	20	Wednesday	Fall quarter ends, Christmas vacation begins 5:20 p.m.

1923

January	4	Thursday	Christmas vacation ends, winter quarter begins, 8:30* a.m.
January	12	Friday	Examinations in French and German for candidates for all advanced degrees
February	12	Monday	Lincoln's birthday; a holiday
February	22	Thursday	Washington's birthday; a holiday
March	23	Friday	Winter quarter ends, spring vacation begins, 5:20 p.m.
March	30	Friday	Good Friday; a holiday
April	4	Wednesday	Spring vacation ends, spring quarter be- gins, 8:30* a.m.
April	12	Thursday	Examinations in French and German for candidates for all advanced degrees
May	9	Wednesday	Last day for filing theses of candidates for all advanced degrees
May	26	Saturday	Last day for filing written examinations for candidates for all advanced degrees
May	30	Wednesday	Memorial Day; a holiday
June	2	Saturday	Last day for oral examinations for can- didates for all advanced degrees
June	9	Saturday	Last day for filing bond for publication of Doctor's thesis; last day for depos- iting binding fee for Master's thesis
June	17	Sunday	Baccalaureate service
June	19	Tuesday	Spring quarter closes, 5:20 p.m.
June	20	Wednesday	Fifty-first annual commencement
June	26	Tuesday	Summer Session and summer quarter begin

* First hour classes begin at 8:15 at University Farm.

THE GRADUATE SCHOOL ORGANIZATION

The Graduate School has exclusive control of all graduate work carried on in the University. The graduate faculty is composed of those properly approved and qualified to offer courses carrying graduate credit. It determines the general educational policy of the Graduate School, and recommends candidates for degrees. The administration of the Graduate School is committed to the dean and an Executive Committee of seven members. They are assisted by group committees representing allied lines of work grouped together for administrative purposes. The groups are as follows:

- a. Social Sciences and Law
- b. Physical Sciences, Mathematics, and Engineering
- c. Biological Sciences
- d. Philosophy and Education
- e. Language and Literature
- f. Medicine
- g. Agriculture

ADMISSION

Any graduate holding a Bachelor's degree or its equivalent from a reputable college or university will be admitted to the Graduate School without examination, and may register for such graduate work as he may be found prepared to enter upon, but he will not thereby be admitted to candidacy for either of the higher degrees until his case has been duly considered and approved.

All inquiries concerning admission to the Graduate School should be addressed to the dean. The student is advised to obtain and fill out an application for admission before presenting himself for registration.

If the rating of the institution from which he received his first degree is such that he will need a year or more of additional work before beginning graduate work at the University of Minnesota, he is advised to enter one of the undergraduate colleges of the University and obtain the preliminary training and an acceptable Bachelor's degree.

College graduates who simply desire to take additional work of undergraduate grade without a view to preparation for an advanced degree should register as unclassified students in the college giving the work.

REGISTRATION

Full directions concerning registration will be found in a booklet issued by the registrar's office for the information of new students. The essential document is an official transcript of the student's college record.

FEES

Tuition fees (per quarter).....	\$10.00
Deposit (first quarter only).....	2.00
Minnesota Union or Shevlin Hall (per quarter).....	1.00
Post-office box (per quarter).....	.20
Special fees	
Special examinations.....	5.00
Chemistry deposit.....	5.00

FELLOWSHIPS AND SCHOLARSHIPS

Four graduate fellowships have been established by the late Thomas H. Shevlin, of Minneapolis. These are awarded one each in the College of Agriculture, Forestry, and Home Economics, the School of Chemistry, the Medical School, and the College of Science, Literature, and the Arts. Each fellowship yields \$500 per annum. They are awarded annually. Candidates for these fellowships should file their applications before March 1 with the dean of the Graduate School.

Shevlin fellows will devote their entire time to the graduate work for which they are registered, and may not engage in private tutoring or be required to render any service to the University.

THE ALBERT HOWARD SCHOLARSHIP

This scholarship, founded by Mr. James T. Howard, yields \$240 annually. The holder is expected to do graduate work in Liberal Arts.

THE CLASS OF 1890 FELLOWSHIP

On the twenty-fifth anniversary of its graduation the class of 1890 founded a fellowship yielding \$150 and exemption from tuition. This fellowship is open to graduates of the colleges of Science, Literature, and the Arts, and Engineering and Architecture desiring to pursue advanced work. Applications should be filed with the dean of the Graduate School before March 1.

DEPARTMENTAL SCHOLARSHIPS

Besides the above stipends there are about seventy scholarships assigned to various departments, yielding \$225 and exemption from tuition and fees. The holders may be required to render service not to exceed ten hours a week in laboratory or office work, or not more than three hours in classroom assistance. Where these regulations are observed, a qualified holder of one of these scholarships may become a candidate for the Master's degree on the basis of one year's work in residence.

Other assistantships and teaching fellowships, some yielding as high as \$1,000 are available, but the amount of work required is greater and the length of residence of the holder of one of these appointments would be increased proportionately.

Inquiries and requests for application blanks may be addressed to the dean of the Graduate School, or to the head of the department in question.

GRADUATE WORK IN THE SUMMER

Work of graduate character done in the Summer Session of the University of Minnesota under a member of the graduate faculty may be counted for residence credit for advanced degrees. The course work for the Master's degree may be completed in four summer sessions. Students working for the Master's degree in summer sessions must file the subjects of their theses before the completion of the first half of the required work.

An increasing amount of graduate work in fields of interest to high school teachers is being offered in the Summer Session. The courses for any session may be found in the bulletin of the Summer Session.

Students who desire graduate credit for work in the summer must register with the dean of the Graduate School.

GRADUATE WORK IN MEDICINE

Graduate work in the laboratory departments and in the clinical branches leading to advanced degrees is offered by the University of Minnesota. This work is under the direction of the Graduate School, and candidates for admission and degrees must meet the requirements of the Graduate School as outlined in the preceding pages. The work is offered by members of the medical faculty in Minneapolis and by members of the graduate faculty on the Mayo Foundation at Rochester, Minnesota, where part or all of the residence work may be done. Several teaching fellowships supported by the University and others on the Mayo Foundation are open to qualified students pursuing graduate work in clinical medicine or in the laboratory branches. A special bulletin on graduate work in medicine is published and may be obtained from the registrar.

WORK IN THE LAW SCHOOL

Under certain properly approved conditions graduate students may offer courses in law as a minor for an advanced degree when their major work is in the Department of Political Science or Economics.

REQUIREMENTS FOR THE MASTER'S DEGREE

The degree of master of arts is, in general, conferred for advanced non-technical study; the degree of master of science for advanced technical study, such as agriculture, industrial chemistry, engineering, etc.

The requirements for the degree of master of arts or master of science are covered in general by the statement that these degrees may be earned by properly qualified students only by at least one full academic year's work in residence at this University (three quarters). Students who have not had adequate preparation in the specific chosen field of

work, or who are doing outside work in excess of ten hours a week, will require more than one year to attain the Master's degree.

Upon entrance to the Graduate School, the candidate, with the approval of the dean, will select his adviser in the field of his major work. With the approval of his adviser and the dean, he will also select a minor, and will outline a study program for the year.

Program of study.—A full program for a student who expects to meet the requirements in one academic year must cover the necessary courses in the fields of the major and minor and the preparation of a satisfactory thesis. The work must be selected from graduate courses offered in this bulletin and must amount to not less than 6 or more than 9 credit hours each quarter. In addition, thesis work (or courses upon which the thesis is based) should be carried to make a total of not less than 15 hours per week for three quarters.

The major.—The major work must be in a department in which the candidate has had at least three years of work (18 semester or 27 quarter credits) if it be a department open to freshmen, or two years of work (12 semester or 18 quarter credits) if it be a department not open to freshmen. Part or all of this preliminary work may consist of designated prerequisite courses in the same or allied departments. Any special requirements will be noted in the corresponding departmental statement. At the end of the year, a final written examination (in addition to the usual course examinations) will be given in the major as noted below.

The minor.—The minor subject must be selected in a department in which the candidate has had at least one year's work (6 semester or 9 quarter credits), or he must have had in a closely allied department a year's work (6 semester or 9 quarter credits), which is actually designated as a prerequisite to the minor subject. Any special requirements will be noted in the corresponding departmental statements.

The choice of the minor must be in a department whose work can be logically related to that of the department in which the student is doing his major work.

The group committee may in exceptional cases allow the minor subject to be taken in the same department as that of the major.

The language requirement.—A reading knowledge of a foreign language, modern or ancient, the language to be determined by the major department, is required of candidates for the Master's degree, unless exemption is made in individual cases with the approval of the Executive Committee of the Graduate School. When no other statement is made in the departmental announcement in this bulletin, a knowledge of either French or German is expected. The candidate shall present to the dean of the Graduate School, not later than the close of the second quarter of residence, a certificate of proficiency in the designated language, signed by the professor in charge of the corresponding language department or his representative.

Candidates for the Master's degree in any department in the language and literature group who register after September 1, 1922, will be required

to have a reading knowledge of two foreign languages before they are recommended for the degree.

All examinations to meet the language requirement of the Graduate School, unless otherwise arranged with the language departments, shall be held on the days specified in the calendar at the beginning of this bulletin.

A candidate who fails in a language examination for an advanced degree shall not be given a second examination until the following quarter.

The Master's thesis.—Before the middle of the first quarter in residence the candidate should file at the office of the Graduate School the subject of his thesis. This subject must be approved by his adviser and by the corresponding group committee. It should be on a topic falling within the field of the major. It is expected that the candidate will devote approximately one half his time to the preparation of the thesis, including courses on which the thesis is based. The thesis must be written in acceptable English and show ability to work independently, and give evidence of power of independent thought both in perceiving problems and making satisfactory progress toward their solution. Familiarity with the bibliography of the special field and correct citation of authorities are expected.

The thesis is required to be in triplicate in order to facilitate its consideration. One copy must be upon the specially required linen stock and the other two may be carbon copies on cheap paper. Samples in the dean's office of both the linen stock and carbon paper should be examined before the thesis is typewritten. The body of the thesis should be double spaced, but footnotes may be single spaced.

The thesis must be finished and three copies deposited in the office of the dean of the Graduate School at least six weeks before the candidate presents himself for his degree.

The thesis will be examined by a committee of three, appointed by the dean on the recommendation of the group committee. The student's adviser will, as a rule, be the chairman of this committee. Unanimous approval by this committee will be necessary for the acceptance of the thesis.

If the thesis is accepted, the candidate must deposit with the registrar, at least one week before commencement the sum of one dollar for binding one copy of this thesis, which will be cataloged and deposited in the University Library.

Examinations.—All candidates for this degree will meet the regular requirements as to examinations, topics, reports, etc., of the classes in which they are registered. A special examination in the field of the minor is not required, but this does not excuse the candidate from the regular course examinations. Besides the usual course examinations, where such are given, the candidate for the Master's degree must pass a final written examination in the major and after the acceptance of the thesis, a final oral examination.

The final written examination will be held not later than four weeks before the end of the quarter in which he takes his degree. It will cover the work of the candidate in the field of the major, and may include any

work fundamental thereto. This examination will be held by his instructors in the major department; the adviser acting as chairman.

If the final written examination is satisfactory, and the thesis accepted, the final oral examination of the candidate will be held, not later than two weeks before the end of the quarter in which he takes his degree. The adviser will act as chairman of the examining committee, which will include all the instructors with whom the candidate has taken work, the thesis committee, and, ex-officio, the head or chairman of the department in which the major work is done. Any member of the graduate faculty may attend as a visitor, and due notice shall be sent by the chairman of the committee to all members of the graduate faculty in the major and minor departments. The final oral examination will cover all the work offered for the degree, and may include other work fundamental thereto. At the close of the examination, the committee will vote upon the candidate, taking into account all of his work. A majority vote is required for approval.

Candidates who are eligible for the "preliminary examination" for the Doctor's degree may substitute this examination for the final oral examination for the Master's degree, provided that all other requirements for the Master's degree have been met.

Reports.—Special blanks are provided for signed reports concerning the thesis and the final oral examinations. All reports must be filed in the office of the dean of the Graduate School at least one week before the end of the last quarter.

Candidates meeting the requirements as above outlined will be reported by the dean to the graduate faculty, who will by vote recommend to the Board of Regents those approved for degrees.

Candidates upon whom degrees are to be conferred are required to be present at commencement, unless especially excused by the dean of the Graduate School and the president of the University.

TABULAR SUMMARY OF REQUIREMENTS FOR THE MASTER'S DEGREE

WORK	UNDER THE DIRECTION OF	DATE
Program, major and minor	Adviser and dean of the Graduate School.....	On entrance.
Approval of thesis subject	Adviser and group committee	Middle of first quarter in residence.
Language requirement....	Adviser and language department	Before close of second quarter.
Approval of candidacy....	Executive committee.....	Beginning of third quarter.
Filing thesis.....	Dean of the Graduate School	At least six weeks before graduation.
Examination of thesis....	Thesis committee.....	Before admission to final oral examination.
Final written examination in major	Major department members of the graduate faculty	Not later than four weeks before commencement and before final oral.
Final oral examination on all work	Thesis committee; all candidate's instructors; head of major department...	Not later than two weeks before commencement.

(Course examinations as required at the usual times.)

Fee for binding thesis....	Registrar	One week before commencement.
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THE ENGINEER DEGREES

Requirements.—Until and including 1923, the advanced professional degrees civil engineer, mechanical engineer, electrical engineer, and chemical engineer will be conferred upon the recommendation of the Graduate School faculty as a result of the satisfactory completion of the following requirements:

(a) A Bachelor's degree in the corresponding branch of engineering from an approved school.

(b) One academic year's study in residence (three quarters) at this University, including

(c) A thesis.

Students who have not had adequate preparation in the specific chosen field of work, or who are doing outside work in excess of twelve hours a week, will ordinarily require more than one year to attain the degree.

If the candidate's Bachelor's degree is in another branch of engineering than that in which the professional degree is sought, he must complete the equivalent of the subjects required for the Bachelor's degree in the new field before admission to candidacy for the desired degree.

Upon entrance to the Graduate School, the candidate, with the approval of the dean, will select his adviser in the field represented by the desired degree, in which field the major work and the thesis will lie. With the approval of his adviser and the dean, he will also select a minor, and will outline a study program for the year.

For program of study, thesis, examinations, etc., see Requirements for the Master's Degree above.*

TABULAR SUMMARY OF REQUIREMENTS FOR
THE ENGINEER DEGREES

WORK	UNDER THE DIRECTION OF	DATE
Program, major and minor	Adviser and dean of the Graduate School.....	On entrance.
Approval of thesis subject	Adviser and group committee	Middle of first quarter in residence.
Approval of candidacy....	Executive committee.....	Beginning of third quarter.
Filing thesis.....	Dean of the Graduate School	At least two weeks before graduation.
Examination of thesis....	Thesis committee	
Final written examination	Major department members of the graduate faculty	Not later than two weeks before commencement.
(Course examinations as required at the usual times.)		
Fee for binding thesis....	Registrar	One week before commencement.

New requirements.—After June, 1923, the following new requirements for the Engineer degrees will replace the present ones. Prior to that time, candidates who so elect may be permitted to graduate under these new requirements.

* For the engineer degrees, the language requirement is waived except for chemical engineers, who must have German; the final oral examination is not required; and the thesis must be filed at least *two* weeks before graduation.

The procedure will be analogous to that described above and will be announced in detail at a later time.

(d) A Bachelor's degree, from an approved school, in the corresponding branch of engineering.

(e) One full academic year of graduate engineering study (three quarters) in residence at this University. (Graduates of this University may be permitted to carry on this study in absentia under the direction of the faculty.)

(f) Four years of engineering experience in positions of responsibility, subsequent to receiving the Bachelor's degree. (If the graduate study is done in absentia, five years of experience are required.)

(g) A thesis of professional grade.

For graduates of this University, a Master's degree in the corresponding branch of engineering will be accepted as fulfilling the requirements of the year of graduate study.

The Engineer degree will not be granted in less than five years after receiving the Bachelor's degree.

MASTER OF SCIENCE IN ENGINEERING AND ARCHITECTURE

The requirements and procedure for the degree of master of science in civil, mechanical, electrical, or chemical engineering or architecture will correspond to those outlined for this degree in other subjects. The language requirement will be waived in all of these cases except chemical engineering, in which German is required.

DOCTOR'S DEGREE

In the Graduate School, one Doctor's degree, doctor of philosophy (Ph.D.), is conferred by the University of Minnesota. This degree is granted, not on the basis of successful completion of a definite amount of prescribed work but solely in recognition of the candidate's high attainments and ability in this special field, to be shown, first, by the preparation of a thesis, and second, by successfully passing the required examinations covering both the general and the special fields of the candidate's subjects as detailed later.

Candidates for the Doctor's degree must devote at least three years¹ of graduate study to approved subjects. The first two years or the last year must be spent in residence at the University of Minnesota.

A member of the staff of instruction above the rank of instructor will not be permitted to enroll for a Doctor's degree at this University. There is no objection, however, to his registering for graduate work at this University and credit so obtained may be presented elsewhere.

¹ This time requirement will be met in three years only by those students who devote all their time to graduate study. Students who merely devote the intervals of professional or other regular employment to graduate study will need to extend their total period of work over a longer period of time. Credit for such work will be given in proportion to the amount of time actually spent in the pursuit of graduate work.

PROGRAM OF WORK

First year.—Upon entrance to the Graduate School, the student shall select his adviser with the approval of the dean. With the approval of his adviser he shall submit to the dean a program covering his first year's work.

Second and third years.—Before beginning the work of the second year, the student shall submit to his adviser and the group committee for approval a tentative outline of his work for the second and third years, including both the major and minor subjects. This program is then to be submitted to the dean for final approval.

Language requirements.—Before admission to the preliminary examination, the student must present to the dean of the Graduate School statements from the French and German departments, certifying that the applicant has a reading knowledge of those languages. The substitution of other foreign languages of greater service in the major field may be permitted by the executive committee on recommendation of the group committee. In addition, a knowledge of other languages may be required in certain cases, as the candidate's major department may prescribe. The student's adviser or his representative shall attend the language examinations and provide literature in the major field from which the test passages are selected. For the data of these language examinations consult the calendar at the beginning of this bulletin.

THE MAJOR WORK

The major work must be in a department in which the candidate has had, in his undergraduate study, at least three years of work (18 semester or 27 quarter credits) if it be a department open to freshmen, or two years of work (12 semester or 18 quarter credits) if it be a department not open to freshmen. Part or all of this preliminary work may consist of designated prerequisite courses in the same or allied departments.

During the period of work for the Doctor's degree a student shall spend not less than two thirds of his time¹ on the major subject, including the work on the thesis. During the last two years, he shall carry an average of at least one course per quarter in his major outside the work from which this thesis is developed.

At the close of the second year's work, and before admission to the preliminary examination, the student must obtain the written recommendation of the major department members of the graduate faculty. Such written recommendations should state that in view of the work already done by the applicant, the department is convinced of his probable capacity and ability to meet all the requirements for the degree, including the thesis, the subject of which must be stated.

In the case of a student who comes for the last year of residence only, provision for the examination will be made by the dean and the major department.

¹ In estimating the distribution of time, a week of 15 credit hours may be assumed.

THE MINOR WORK

The minor work must be selected in a department in which the student is prepared to pursue courses advanced enough in character to be included in the group designated "For Undergraduate and Graduate Students," and numbered 100 or above.

The choice of the minor must be in a department the work of which can be logically related to that of the department in which the student is doing his major work.

In exceptional cases, the dean and the group committee may allow the minor subject to be taken in the same department as that of the major or in two related departments.

Not less than one sixth of the total work of the three years shall be devoted to the minor subjects and all of this work shall be completed and certified to by the department in which the minor is taken before admission to the preliminary examination.

THESIS

The thesis, for which the accumulation of material may well be started not later than the beginning of the second year, must give evidence of originality and power of independent investigation, and embody results of research, which form a real contribution to knowledge as well as exhibit mastery of the literature of the subject and familiarity with the sources of knowledge. The matter must be presented with a fair degree of literary skill.

Not later than six weeks before the commencement at which he expects to take the degree, the student shall deposit at the dean's office his thesis, typewritten, in triplicate copy to facilitate reading by the thesis committee. The requirements concerning form, copyrighting, and printing adopted in June, 1922, may be consulted in the Graduate School office.

The dean will appoint a thesis committee with the student's adviser as chairman. The duty of this committee will be to read the thesis and vote upon its acceptance. Unanimous approval by this committee will be necessary to such acceptance.

Printing of the thesis.—If the thesis be accepted, the student shall deposit with the registrar, not later than one week before graduation, a sufficient bond or such sum of money as is needed to print one hundred copies of the thesis for the use of the University and as many additional copies as the candidate may require for himself. If the thesis is to be published elsewhere, reprints will be acceptable, if bound with covers in the special form required by the University.

EXAMINATIONS

Preliminary.—After the language examinations (see p. 14) and at least one calendar year before the degree is conferred, a preliminary examination of the student shall be given by a committee appointed by the dean and including the student's adviser as chairman, a representative of the group committee other than his adviser, the chairman or head of the

major department, a representative of the minor department, and such other members as the dean may consider advisable. Certificates of proficiency in French and German and completion of the minor and the recommendation of the major department shall be required before admission to this examination. The examination shall cover graduate work previously taken by the student, and *may include any work fundamental thereto*, except the thesis and the field of definite specialization. This examination shall be in addition to the usual course examinations. It may be written or oral, or both, at the discretion of the committee. Only after the successful completion of this examination may the student be enrolled as a candidate for the Doctor's degree. Students failing to pass this preliminary examination may be excluded from candidacy for the degree and in any case shall not be reexamined until at least one quarter has passed.

Final written.—After the thesis is presented, and at least four weeks before examination, there shall be a written examination in the major subject, to be given by the members of the graduate faculty in the major department. This examination shall cover all the work done in the major, and *may include any work fundamental thereto*.

Final oral.—After successful completion of the written examination and acceptance of the thesis and not less than two weeks before graduation, the final oral examination shall be given. This examination shall be conducted by a committee consisting of the adviser as chairman, of a majority of the members of the graduate faculty of the department in which the major work was done and at least three other members of the graduate faculty appointed by the dean. At least one member of this committee shall be from a group other than the one in which the major department is included. This examination has special reference to the thesis and the field of the candidate's special studies and shall not exceed three hours.

The date of the final oral examination shall be publicly announced and the examination shall be open to any member of the graduate faculty. Upon completion of the examination, a formal vote of the committee shall be taken, and an affirmative vote of at least two thirds of the members shall be necessary for recommendation of the candidate for the degree.

Reports.—Special blanks are provided for signed reports concerning the thesis and the final oral examinations. All reports must be filed in the office of the dean of the Graduate School at least one week before graduation.

Candidates meeting the requirements as above outlined will be reported by the dean of the graduate faculty, who will by vote recommend to the Board of Regents those approved for degrees.

Candidates upon whom degrees are to be conferred are required to be present at commencement, unless especially excused by the dean of the Graduate School and the president of the University.

TABULAR SUMMARY OF REQUIREMENTS FOR
THE DOCTOR'S DEGREE

WORK	UNDER THE DIRECTION OF	DATE
FIRST YEAR		
Major	} Adviser and dean of Graduate School.....	On registration.
Minor		
SECOND YEAR		
Tentative program of entire second and third years' work	Adviser, group committee, and dean of Graduate School	Before beginning work of second year.
Major, including thesis...	As for tentative program	} Before admission to preliminary examination.
Minor	Adviser and minor department	
Language	Adviser and language department	
Recommendation	By major department....	
Preliminary examination...	Special committee.....	One calendar year before degree is to be conferred.
THIRD YEAR		
Major, including thesis,...	Advisers, group committee, and dean of Graduate School	
Filing of thesis.....	Dean	Six weeks before taking the degree
Examination of thesis....	Thesis committee.....	Before admission to final oral examination.
Final written examination	Major department members of the graduate faculty	Four weeks before taking degree and before final oral examination.
Final oral examination...	Advisers, majority of members of major department, and other members appointed by dean of Graduate School....	Not later than two weeks before taking the degree.
Bond for publication of thesis	Registrar	Not later than one week before taking the degree.

COURSE DESCRIPTIONS

EXPLANATIONS

A dagger (†) indicates that all quarters of a course must be completed before credit is received for any quarter.

AGRICULTURAL BIOCHEMISTRY

Professors ROSS AIKEN GORTNER, CLYDE H. BAILEY, LEROY S. PALMER;
Assistant Professors CORNELIA KENNEDY, CLARENCE A. MORROW,
JOHN J. WILLAMAN.

Prerequisites.—For major work, credit in general chemistry and qualitative analysis, in organic chemistry, in quantitative analysis, and at least ten quarter credits in biological science. The work presented as prerequisite must be satisfactory to the instructor with whom the student wishes to work.

For minor work, credit in general chemistry and qualitative analysis, in organic chemistry, and 10 quarter credits of biological science. Minors should be arranged only after consultation with the instructors concerned.

Candidates for the Master's degree must have a reading knowledge of German or French. (In special cases, where other languages are needed for the development of the thesis, Russian, Italian, or the Scandinavian languages may be substituted.)

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f, su-102w, su. AGRICULTURAL QUANTITATIVE ANALYSIS. Includes estimation of inorganic and organic constituents of biological products, proximate analysis of foods and feeding stuffs, and the use of special apparatus. Prerequisite: quantitative analysis. Three credits each quarter. V, VI, VII; MWF; 7Ch. MR. MORROW.
- 103s. DAIRY CHEMISTRY. Lectures and laboratory work on the physical, colloidal, and chemical properties of milk and dairy products, and of the processes involved in the manufacture of dairy products. V, VI, VII; MWF; 7Ch. MR. PALMER.
- 108s. CHEMISTRY OF WHEAT AND WHEAT PRODUCTS. A lecture course, with collateral library reference work, on the chemical technology of the production and milling of wheat and its conversion into food. Prerequisite: organic chemistry. Three credits. I; MWF; 201Ch. MR. BAILEY.
109. SELECTED FLOUR LABORATORY METHODS. A laboratory course in which particular attention is given to recently developed methods for testing wheat products. Less extensive than 110. Designed for men with commercial laboratory experience. Prerequisite: Course 101-102 or Chemistry 131-132, parallel 108. Three credits. V, VI, VII, VIII; MW; 7Ch. MR. BAILEY.

- 110S,su.¹ FLOUR LABORATORY METHODS. A laboratory course. Analyses of wheat and its products. Designed to train students for research in the cereal industry. Prerequisite: Course 101-102 or food analysis. Five credits. V, VI, VII, VIII; MWF; 7Ch. MR. BAILEY.
- 111f,su-112w,su. PHYTOCHEMISTRY. An advanced course dealing with the colloidal state, and the chemistry of proteins, carbohydrates, glucosides, tannins, fats, plant acids, enzymes and pigments, and their physicochemical relations to the vital processes involved in growth and nutrition. Prerequisites: organic chemistry, biology, 1 year. Three credits each quarter. III; MWF; 201Ch. MR. MORROW.
- 113f,su-114w,su. BIOCHEMICAL LABORATORY METHODS. A laboratory course paralleling the lectures in 111-112. Prerequisite: quantitative analysis, parallel 111-112. Two or 3 credits each quarter. V, VI, VII, VIII; TTh; 7Ch. MR. MORROW.
- 116w. ADVANCED ANIMAL NUTRITION. Recent developments in animal nutrition, covering the field of proteins, mineral metabolism, vitamins, and the relation of nutrition to disease. Prerequisite: Course 15 or equivalent. Two credits. III; TTh; 351Ch. MR. PALMER, MISS KENNEDY
- 117f,w,s,su. LABORATORY PROBLEMS IN ANIMAL NUTRITION. A laboratory course on methods used in nutrition studies. (Because of limited laboratory facilities, students planning to register for this course should obtain permission from the instructors before registration. Prerequisite: Course 115. Three to 5 credits. Ar. MR. PALMER, MISS KENNEDY.
- 118f,w,s,su. LABORATORY PROBLEMS IN BIOCHEMISTRY. Special laboratory work in the preparation and isolation of pure compounds, and in special methods of identification or determination of biochemical products. Prerequisites: Courses 111-112, 113-114; or 103 or 110. Three or 5 credits. MR. GORTNER, MR. BAILEY, MR. PALMER, MISS KENNEDY, MR. MORROW, MR. WILLAMAN.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f,w,s,su. SEMINAR. Regular meetings for the discussion of methods of research, formulation of research problems, and reviews of current literature. Required of all majoring in this division and of all minor-ing for the Doctor's degree. One credit. MR. GORTNER.
- 203f,w,s,su. RESEARCH PROBLEMS. Special work on particular research problems other than the student's major thesis. Facilities are provided for biochemical investigations and for advanced studies in plant, animal, or human nutrition. Three or 5 credits. MR. GORTNER, MR. BAILEY, MR. PALMER, MR. MORROW, MR. WILLAMAN.

¹ Offered in alternate summers. Offered in 1923.

- 205f,w,s,su. SPECIAL TOPICS IN BIOCHEMICAL LITERATURE. Library work followed by the preparation of written reports upon either the historical development or the "current literature of special biochemical problems. A reading knowledge of German is necessary and of French desirable. Prerequisite: Course 206, 207, or 208. Three credits. MR. GORTNER.
- 206f. COLLOIDS. Lectures dealing with the colloidal state, the preparation and properties of colloidal solutions, and the relation of these to biochemical processes. Prerequisite: Course 111-112, or physical chemistry. Three credits. II; MWF; 351Ch. MR. GORTNER.
- 207f. ENZYMES. Lectures dealing with the nature of enzyme action, including methods of preparation and investigation of enzymes, their physical and chemical properties and their methods of action. Prerequisites: Course 111-112, or physiologic chemistry. Three credits. III; MWF; 351Ch. MR. WILLAMAN.
- 208w. PROTEINS. Lectures on the composition, structure, biochemical reactions, and functions of the protein and amino acids, with special emphasis upon those which are concerned in plant growth and metabolism, animal food, and industrial processes. Prerequisite: Course 111-112, or advanced organic chemistry. Three credits. II; MWF; 351Ch. MR. GORTNER.
- 209w. CARBOHYDRATES. A lecture and library course on the synthesis, structure, reactions, and functions of carbohydrates, with especial reference to those which are of plant or animal origin and which play a rôle in biochemical or industrial processes. Prerequisite: Course 111-112, or advanced organic chemistry. Three credits. II; TThS; 351Ch. MR. MORROW, MR. WILLAMAN.
- 212w,su. SPECIAL TOPICS IN NUTRITIONAL CHEMISTRY. A course comprising lectures, independent library study, and oral presentation by students, of special assigned topics in animal nutrition. A reading knowledge of German is essential and French desirable. Prerequisite: Course 116. Three credits. MR. PALMER.

AGRONOMY, FARM MANAGEMENT, AND PLANT BREEDING

Professors ANDREW BOSS, HERBERT K. HAYES; Associat  Professor ALBERT C. ARMY.

Prerequisites.—In farm crops and plant-breeding, for major work, Courses 121, 122, 131, 132, or their equivalents, and a reading knowledge of German or French. For advanced work in plant-breeding, and with the approval of the adviser, courses in agricultural biochemistry, botany, farm crops, horticulture, plant pathology, and plant physiology, may be accepted as major work. For minor work, two years of botany, one year of zoology, and the elementary courses in farm crops. Students majoring

in plant-breeding are required to continue study during at least one summer. Exemption is made if similar training has been obtained at some other institution.

In farm management, for major work, Courses 103 and 104, or their equivalent, and at least 6 credits in elementary and agricultural economics. For minor work, at least 12 credits in the elementary agricultural sciences (Farm Crops 1, Soils 3, and Animal Husbandry 3 and 7). Exemption from the language requirement for the Master's degree may be made in individual cases.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 102f,w,s. FARM MANAGEMENT II. The business side of farming and farm organization and equipment is emphasized. Prerequisites: Farm Crops 1, Economics 5, Animal Husbandry 6 or 8, Soils 2. Three credits. II; MWF; 24Ad(F). Mr. Boss.
- 103w,s. FARM MANAGEMENT II. A continuation of Course 102 with special attention to farm operation. Prerequisites: same as above and Agronomy and Farm Management 102. Three credits. I; MWF; 24Ad(F). Mr. Boss.
- 104s. FARM MANAGEMENT III. An advanced course, covering cost of production studies, farm business analysis, farm practice, and farm management literature. Prerequisites: Agronomy and Farm Management 102 and 103. Three credits. II; MWF; 18Ad(F). Mr. Boss.
- 121f. CEREAL CROPS. An advanced study of the cereal crops. Structure, group classification, improvement, growing, and utilization. Brief score card practice and a limited amount of placing on intrinsic value included. Prerequisites: Farm Crops I, botany, 10 credits. Three credits. VI, VII; TTh; 2Ad (F). Mr. ARNY.
- 122w. CORN AND POTATO CROPS. A study of the corn and potato crops similar to that outlined for cereal crops. Prerequisites: Farm Crops I, botany, 10 credits. Three credits. V, VI, VII; TTh; 2Ad (F). Mr. ARNY.
- 123s. FORAGE AND FIBER CROPS. A study of the forage crops through assigned reading, laboratory and field work. Prerequisites: Farm Crops I, botany, 10 credits. Three credits. V, VI, VII; TTh; 2Ad(F). Mr. ARNY.
- 131f. PRINCIPLES OF GENETICS. Same as Horticulture 109. Designed to familiarize students with underlying principles of breeding. Prerequisites: botany, 9 credits, animal biology, 10 credits. Three credits. I; TThS; 24Ad(F). Mr. BEAUMONT, Mr. GRIFFEE.
- 132s,su. FARM CROPS PLANT-BREEDING. Applied genetics is emphasized. Prerequisites: Agronomy and Farm Management 131. Three credits. I, II; TTh, II, S; 4Ad(F). Mr. HAYES, Mr. GRIFFEE.

- 133w. JUDGING AND GRADING FARM CROPS. Prerequisites: Agronomy and Farm Management 1, 121, 122. Course 122 may be concurrent. VIII; TTh; 2Ad(F). MR. ARNY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201Ar. RESEARCH IN PLANT-BREEDING. May be taken as major or minor work. Prerequisites: Agronomy and Farm Management 131, 132. MR. HAYES.
- 203f,w,s, or HORTICULTURE 213f, 214w, 215s. PLANT-BREEDING SEMINAR. History, recent genetic theories, and a discussion of research problems. Weekly meetings throughout the year. Prerequisite: Agronomy and Farm Management 131. Maximum of 3 credits. MR. HAYES.
- 205f. FARM BUSINESS ANALYSIS. Special and intensive work in studying the various factors entering into farm organization. Prerequisites: 9 credits in farm management. Ar. Three credits. MR. BOSS.
- 207w. COST OF PRODUCTION STUDIES. Prerequisites: 9 credits in farm management. Three credits. Ar. MR. BOSS.
- 209Ar. RESEARCH IN FARM CROPS. It is desirable that students remain during one summer to work out research problems. Prerequisites: 9 credits in farm crops. MR. ARNY.
- 211w. TOPICS IN PLANT-BREEDING LITERATURE. Emphasis is given to field plot technique, the results of inbreeding and outbreeding, and the results of selection and crossing as a means of improving crop plants. Practice in outlining the correct mode of attack for special plant-breeding problems. Prerequisites: Agronomy and Farm Management 132. Three credits. MR. HAYES.
- 213f,w,s. FARM CROPS SEMINAR. Weekly meetings for the discussion of current literature and for reports of thesis problems. Prerequisites: 9 credits in farm crops. Maximum of three credits. MR. ARNY.
- 214Ar. SPECIAL TOPICS IN FARM CROPS LITERATURE. Library work, including the making of abstracts, reviews, and bibliographies. Prerequisites: Agronomy and Farm Management 121, 122, 123, and a reading knowledge of German. Maximum of 6 credits. MR. ARNY.
- 215w,216s. ADVANCED FARM ORGANIZATION. Analysis of farm organization and the application of survey factors and cost factors in organizing the business of farming. Prerequisites: 12 credits in farm management. Three credits. Ar. MR. BOSS.
- 217f. ADVANCED GENETICS. Current genetic literature. Linkage, genetic stability, chromosomal aberrations, and the probable errors of Mendelian ratios will be emphasized. Prerequisite: Agronomy and Farm Management 131, or Horticulture 109. Three credits. Maximum of 6 credits. MR. HAYES.

ANATOMY

Prerequisites.—The Institute of Anatomy offers excellent facilities to students who wish to take advanced work or to pursue investigations in anatomy.

The prerequisite work for all students for major or minor in the Department of Anatomy includes general zoology (animal biology), 6 credits, and advanced zoology or elementary courses in anatomy (including histology, embryology, and neurology), 6 credits. In addition each student desiring a major in anatomy must have had the elementary courses in that branch of anatomy in which he desires to specialize—gross anatomy, histology, embryology, or neurology.

For staff and the description of courses, see the special bulletin on graduate work in medicine.

ANIMAL BIOLOGY

Professors HENRY F. NACHTRIEB, HAL DOWNEY, JOHN B. JOHNSTON, WILLIAM A. RILEY, ARTHUR G. RUGGLES, CHARLES P. SIGERFOOS; Associate Professor ELMER J. LUND; Assistant Professors ROYAL N. CHAPMAN, HARRY H. KNIGHT, OSCAR W. OESTLUND.

Prerequisites.—For major work, Course 1-2 and at least 18 credits of advanced work approved by the department; for minor work, Course 1-2 or the equivalent.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

109f, 110w, 111s. GENERAL PHYSIOLOGY. A thoro survey of fundamental physiological processes in organisms. Based on Bayliss's *Principles of General Physiology*. Laboratory, lectures, and reading. Ten credits. V-VIII; MWF; 10AB. MR. LUND.

117f-118w-119s.† ECOLOGY OF INSECTS. General principles of ecology with special reference to the insects of Minnesota. Lectures, laboratory, assigned reading, and field work. Nine credits. V-VII; TTh; 202AB. MR. CHAPMAN.

124su. ADVANCED ECOLOGY. Similar to Course 117-118-119 with special field work. Five credits. Ar. 202AB. MR. CHAPMAN.

125f-126w-127s.† ADVANCED ENTOMOLOGY. Morphology and classification of insects, with lectures on the history of entomology. Nine credits. III, IV; TThS; 204AB. MR. OESTLUND.

130w. BIOLOGY AND TAXONOMY OF THE APHIDIDAE. Intensive study of the natural history, bibliography, and classification of the Aphididae. Three credits. III, IV; MWF; 204AB.

139-140.† HISTOLOGY AND DEVELOPMENT OF INSECTS. Lectures and laboratory work on the histology, embryonic and postembryonic development of insects. Six credits. II, III, IV; TTh; 324AD(F). MR. RILEY.

- 144f-145w-146s. ANIMAL PARASITES AND PARASITISM. Lectures and laboratory work. Origin and biological significance of parasitism; the structure, life history, and economic relations of representative parasites. Second term devoted primarily to the relation of insects to diseases of man and animals. Nine credits. V-VII; WF; 202AB. MR. RILEY.
- 149f-150w-151s.† BLOOD OF VERTEBRATES. A comparative study of blood and blood-forming organs of vertebrates. A portion of time to be devoted to research. Nine credits. Ar.; 201,211AB. MR. DOWNEY.
- 181f-182w.† GENERAL EMBRYOLOGY. Principles and laws of animal development in connection with origin and development of germ cells, sex chromosomes, fertilization, cleavage, etc. Six credits. V, VI; MWF; 201,211AB. MR. NACHTRIEB.
- 183s.† GENETICS AND EUGENICS. Facts and theories of heredity and the application of the laws governing natural inheritance for the improvement of the race. Three credits. IV; MWF; 211AB. MR. NACHTRIEB.
- 197f-198w-199s. PROBLEMS. Advanced work in some special line. Nine or 18 credits. Hours and days arranged. MR. NACHTRIEB, MR. DOWNEY, MR. JOHNSTON, MR. RILEY, MR. SIGERFOOS, MR. LUND, MR. CHAPMAN, MR. OESTLUND.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-204. RESEARCH IN ENTOMOLOGY. Hours and days arranged. MR. RILEY, MR. CHAPMAN, MR. KNIGHT, MR. OESTLUND, MR. GRAHAM.
- 205-208. RESEARCH IN ECONOMIC ENTOMOLOGY. MR. RUGGLES, MR. GRAHAM.
- 209-212. RESEARCH IN ECONOMIC VERTEBRATE ZOOLOGY. MR. WASHBURN.
- 213-216. RESEARCH IN BIOLOGICAL OXIDATIONS. MR. LUND.
- 217-218-219. RESEARCH IN THE PHYSIOLOGY OF THE LOWER ORGANISMS with special reference to the Protozoa. MR. LUND.
- 225-228. RESEARCH ON THE GROSS AND MICROSCOPIC ANATOMY OF THE GANOIDS. MR. NACHTRIEB.
- 229-232. RESEARCH IN ANIMAL HISTOLOGY. MR. DOWNEY.
- 233-236. RESEARCH IN VERTEBRATE CONNECTIVE TISSUE WITH SPECIAL REFERENCE TO THE CELLULAR ELEMENTS. MR. DOWNEY.
- 237-238. RESEARCH IN VERTEBRATE HEMATOLOGY. MR. DOWNEY.
- 245-248. COMPARATIVE NEUROLOGY. A study in the structure and functions of the nervous system of vertebrate animals and of the evolution of the chief nervous mechanisms. Prerequisites: two years in comparative or human anatomy. MR. JOHNSTON.

- 249-252. RESEARCH IN NEUROLOGY. MR. JOHNSTON.
- 253-254. DYNAMICS OF PROTOPLASM AND CELLS. Physical and chemical interpretation of the structure of living protoplasm, and vital processes such as permeability, secretion, enzyme action, regeneration, stimulation, and energy transformation in the living cell. Research accompanied by lectures. MR. LUND.
- 257-260. SENSORY PHYSIOLOGY OF INVERTEBRATES. MR. MINNICH.
- 261-264. RESEARCH IN PARASITOLOGY AND MEDICAL ENTOMOLOGY. MR. RILEY.
- 265-268. RESEARCH IN INSECTICIDES.

ANIMAL HUSBANDRY

Professors WALTER H. PETERS, EVAN F. FERRIN; Assistant Professors PHILLIP A. ANDERSON, NORRIS K. CARNES.

Prerequisite.—Students majoring in this division are exempted from the language requirements for the Master's degree.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f. ADVANCED LIVESTOCK-JUDGING. Three credits. VI, VII; MWF; center arena, St.(F). MR. FERRIN.
- 102s. HORSE HUSBANDRY. Stud farm management; the selection of foundation stock and the breeding, feeding, and marketing of horses. Horsepower; factors determining a horse's efficiency for work. Three credits. II; TTh; 3St.(F) and V, VI, VII; F, center St.(F). MR. PETERS.
- 103s. BEEF CATTLE HUSBANDRY. The management of purebred and grade herds of beef cattle, sales and shows, building equipment, labor, with practical exercises. Three credits. III; MW; 3St.(F) and V, VI, VII; T; BB. MR. CARNES.
- 104s. SHEEP HUSBANDRY. Similar in method to 103, with practice in shearing, blocking, feeding, and caring for lambs. Three credits. IV; WF; 3St.(F) and V, VI, VII; M; center St.(F). MR. ANDERSON.
- 105s. SWINE HUSBANDRY. Topics of 103 as applied to swine production, marketing, costs, feeding, etc. Three credits. II; TS; 3St.(F) and V, VI, VII; Th; center St.(F). MR. FERRIN.
- 106w. ADVANCED MEATS. Practice work in dressing animals and cutting carcasses; also a study of the chemical composition of meat. Three credits. V, VI, VII; WF; Meat Shop. MR. ANDERSON.
- 107s. MEAT PROBLEMS. The wholesale cuts and grades of meat, the packing industry and utilization of by-products, special problems and visits to meat-packing establishments. IV; TS; and V, VI, VII; W; Meat Shop. MR. ANDERSON.

- 108s. SEMINAR. Special assignments and review of investigations pertaining to the livestock industry. Three credits. II; MWF; 3St.(F).
MR. PETERS.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201s. ADVANCED STUDY OF LIVESTOCK-BREEDING. Studies of the methods followed in the building up of breeds of livestock and distinguished blood lines within the breeds. Review of scientific literature on livestock-breeding. Three to 10 credits. MR. PETERS.
202. ADVANCED LIVESTOCK-FEEDING. A study of experimental results bearing upon these questions and review of scientific literature applicable to them. Three to ten credits. MR. FERRIN.
203. THE MARKETING OF LIVESTOCK. A study of the methods used in the principal markets of the world. Three credits. MR. PETERS.
204. MANAGEMENT OF LIVESTOCK FARMS. A study of the economic factors entering into the problems of managing large livestock farms. Three credits. MR. PETERS.
205. EXPERIMENTAL METHODS. Theory, plan, and conduct of experimental work in animal husbandry. Factors affecting results, sources of error, interpretation of data. Three credits. MR. FERRIN.

ANTHROPOLOGY¹

Professor ALBERT ERNEST JENKS.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 108s. PHILIPPINE PEOPLES. Comparative study of the four large ethnic and cultural groups in the Philippine Islands; policy of the insular government as it affects American home interests in the Orient. II; MWF; 25F. MR. JENKS.
110. PHYSICAL ANTHROPOLOGY AND AMALGAMATION. (Not given in 1922-23.) MR. JENKS.
- 112f. THE AMERICAN NEGRO. Development of the American negro; his characteristics, conditions, and developing tendencies. Negro and immigrant adjustments. Prerequisites: three courses. Three credits. IV; MWF; 15F. MR. JENKS.
- 113f. THE AMERICAN PEOPLE—OLDER IMMIGRANTS. Characteristics, contributions, and distribution of the older immigrant peoples in America, their modification and importance. Prerequisites: three courses. Three credits. III; MWF; 15F. MR. JENKS.
- 114w. THE AMERICAN PEOPLE—NEWER IMMIGRANTS. Prerequisites: three courses. Three credits. III; MWF; 15F. MR. JENKS.

¹ Courses in Americanization alone may not be offered as a major for an advanced degree.

- 115s. AMERICAN PEOPLE—AMERICANISMS AND ASSIMILATION. Essential and unique historical Americanisms. Conditions and facts of assimilation. Prerequisites: three courses. Three credits. III; MWF; 15F. MR. JENKS.
- 123f-124w. PROBLEMS IN ANTHROPOLOGY. An advanced course of method and independent research. Six credits. Ar. 12F. MR. JENKS.
- 128f,s. TECHNIQUE OF TEACHING ADULTS. Methods of teaching adults—the foreign-speaking, the illiterate, the fatigued. Prerequisites: three courses. Three credits. I; MWF; F.
- 129w. METHODS OF AMERICANIZATION. Practical methods of Americanization in use in the United States. Prerequisite: Course 128. Three credits. I; MWF; F. MR. JENKS.
- 130s. ORGANIZATION AND ADMINISTRATION OF AMERICANIZATION WORK. Existing Americanization organizations of Federal, state, municipal, and neighborhood groups. Methods of organizing new groups. Prerequisite: Course 128. Three credits. I; MWF; F. MR. JENKS.
- 131f-132w-133s. SUPERVISED AMERICANIZATION WORK. Practical field work among foreign peoples in our vicinity. Prerequisites: three courses. Nine credits. VI; T and ar.; 12F.
- 141f-142w-143s. PRINCIPLES OF ADULT ELEMENTARY EDUCATION. Prerequisite: Course 128. II; MWF; 12F.
- 150f-151w-152s. FIELD PROBLEMS IN AMERICANIZATION. An advanced course of method and independent research. Prerequisite: Course 128. Six credits. IV; MWF; 12F.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 204s. SEMINAR IN ANTHROPOLOGY. Individually directed research. Prerequisites: three courses. Three credits. Ar. 12F. MR. JENKS.

ARCHITECTURE

Professors FREDERICK M. MANN, LEON E. ARNAL.

COURSES

- 119f,w,s. SPECIAL RESEARCHES IN ARCHITECTURAL HISTORY. Prerequisite: completion of undergraduate architectural history. Five credits or less per quarter. III; MW; 320ME. MR. MANN.
- 139f,w,s. ADVANCED ARCHITECTURAL DESIGN. Prerequisite: completion of undergraduate design. Ten credits or less per quarter. VI, VII, VIII, IX; MTWThF; I, II, III, IV; S; 317ME. MR. ARNAL.

ASTRONOMY

Professor FRANCIS P. LEAVENWORTH; Assistant Astronomer WILLIAM O. BEAL.

The Astronomical Observatory contains a ten and one-half inch refracting telescope furnished with a third lens for converting it into a photographic telescope; a five-inch star camera; a filar micrometer; a spectroscope by Brashear; a meridian circle and zenith telescope; a Repsold photographic measuring machine; a chronograph, and astronomical clocks.

Prerequisites.—For major work, Course 51-52-53 and Mathematics 50; for minor work, Mathematics 50 and 3 credits in astronomy.

Exemptions from the language requirement for the Master's degree may be made in individual cases.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

101f-102W-103S. PRACTICAL ASTRONOMY. Theory and use of astronomical instruments; astronomical photography, with measures of plates; study of method of least squares. Prerequisite: Mathematics 50. Three to 6 credits. III; MWF. MR. LEAVENWORTH.

111f-112W-113S. CELESTIAL MECHANICS OBSERVATORY. Prerequisite: Mathematics 51. Three credits. Ar. MR. BEAL.

140W. METHOD OF LEAST SQUARES. Applied especially to engineering, physics, and astronomy. Prerequisite: Mathematics 51. Three credits. II; TThS; 124F. MR. LEAVENWORTH.

COURSES PRIMARILY FOR GRADUATE STUDENTS

201f-202W-203S. ADVANCED PRACTICAL ASTRONOMY. Prerequisite: Astronomy 101-102. Three credits. MR. LEAVENWORTH.

204f-205W-206S. ASTROPHOTOGRAPHY. Prerequisite: Astronomy 102. Three credits. MR. LEAVENWORTH.

208f-209W-210S. CALCULATION OF ORBITS. Prerequisite: Mathematics 51. Three credits. MR. BEAL.

BACTERIOLOGY AND IMMUNOLOGY

Professors WINFORD P. LARSON, EDWARD C. ROSENOW,* ARTHUR SANFORD*
Associate Professor ARTHUR T. HENRICI.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

105f. HOUSEHOLD BACTERIOLOGY. The decay, fermentation, and putrefaction of foodstuffs; molds; canning; food-poisoning; cleansing processes. Prerequisite: general bacteriology. Forty-four hours; 3 credits. VI, VII; TTh. MISS BENTON.

* On Mayo Foundation. See special bulletin on graduate medical work.

- 114s. THE HIGHER BACTERIA. Study of morphology, cultivation, and classification of actinomycetes, yeasts, and molds. Study of the mycoses. Prerequisites: general and special bacteriology. Forty-four hours; 3 credits. VI, VII; TTh. DR. HENRICI.
- 116w. COURSE IN IMMUNITY. Fifth- and sixth-year medical students. Limited to ten students. Forty-four hours, 3 credits. VI, VII; TTh. DR. LARSON.
- 117s. PATHOGENIC PROTOZOA. Study of parasitic Protozoa in man, including spirochaets; intermediate hosts as agents in the spread of disease; cultural methods. Prerequisites: general and special bacteriology; Animal Biology 45 and 107. Forty-four hours; 3 credits. VI, VII; TTh. DR. LARSON.
- 118f. MORPHOLOGY AND TAXONOMY OF BACTERIA. Cytology of bacteria; their origin and systematic position; variations and mutations in bacteria; the biometrical methods as applied to bacteriology. Prerequisites: general and special bacteriology. Forty-four hours; 3 credits. VI, VII; TTh. DR. HENRICI.
- 119f. BACTERIOLOGICAL CHEMISTRY. Chemical analyses of bacteria; physical agents influencing bacterial metabolism; factors stimulating enzyme production; nitrogen fixation. Prerequisites: general and special bacteriology; physiologic chemistry or phytochemistry. Sixty-six hours; 4 credits. Hours to be arranged.
- 120w. CONTINUATION OF 119. Bacterial toxins; "split proteins"; bacterial activity in the alimentary tract; immunochemistry; behavior of bacteria toward electricity. Sixty-six hours; 4 credits. Hours to be arranged.
- 150f-151w (or 150w-151s). ADVANCED BACTERIOLOGY. Special problems. Limited to ten students. Forty-four hours; 3 credits. Hours to be arranged. DR. LARSON, DR. HENRICI.

COURSES PRIMARILY FOR GRADUATE STUDENTS

201. RESEARCH IN BACTERIOLOGY. For qualified graduate students either as major or minor, in bacteriology. Hours and credits arranged. DR. LARSON, DR. HENRICI.
203. SEMINAR IN BACTERIOLOGY. One credit.

BOTANY

Professors C. OTTO ROSENDAHL, ELIAS J. DURAND, LEE I. KNIGHT, JOSEPHINE E. TILDEN; Associate Professor FREDERIC K. BUTTERS; Assistant Professors WILLIAM S. COOPER, RODNEY B. HARVEY.

NOTE.—For courses in plant pathology and mycology, see Department of Plant Pathology.

Prerequisites.—For major work, 36 quarter credits in botany; for minor work, 20 credits.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 107w.** MORPHOLOGY AND TAXONOMY OF BRYOPHYTES. Structure and classification of liverworts and mosses. Prerequisites: Courses 7 and 62. Five credits. Ar. 106AB. MR. DURAND.
- 108w.** MORPHOLOGY AND TAXONOMY OF PTERIDOPHYTES. An intensive study of lycopods, ferns, and their allies. Prerequisites: Courses 7 and 62. Five credits. Ar. 4AB. MR. BUTTERS.
- 110w.** MORPHOLOGY AND TAXONOMY OF GYMNASPERMS. An intensive study of cycads, conifers, and their allies. Prerequisites: Courses 7 and 63. Five credits. Ar. 4AB. MR. ROSENDAHL.
- 113f-114w-115s.** ADVANCED TAXONOMY. Special attention is given to the taxonomy of different natural groups of angiosperms. Prerequisites: 15 credits including Course 7. Nine credits. V, VI; MWF; 213AB. MR. ROSENDAHL.
- 118w.** CYTOLOGY. A study of the origin, development, structure, and functions of the plant cell and its various constituents. Prerequisites: 18 credits. Three credits. V, VI, VII; TTh; 213AB.
- 123-124f-125w-126s.** MORPHOLOGY AND TAXONOMY OF THE ALGAE. Advanced studies in selected groups. Prerequisites: 15 credits including Course 12 for each course. Three credits for each course. V, VI, VII; TTh; 104AB. MISS TILDEN.
- Any of the above courses may be taken separately.
(123 not offered in 1922-1923.)
- 127s.** ANATOMY OF VASCULAR PLANTS. The microscopic structure of vascular plants with particular attention to the development and evolution of the vascular system in the root, stem, and leaf. Prerequisites: 18 credits. Five credits. III, IV; MTWFS; 213AB. MR. BUTTERS.
- 131f.** FIELD ECOLOGY. A survey of the local plant communities and successions, and a study of the general principles of plant association and succession. Prerequisite: Course 21. Five credits. Ar. G. MR. COOPER.
- 132w.** ECOLOGICAL ANATOMY. The individual plant and its parts as related to environment; special plant forms and structures, their causes and significance. Prerequisite: Course 21. Five credits. III, IV; MTWFS; G. MR. COOPER.
- 133s.** FOREST GEOGRAPHY OF NORTH AMERICA. Preliminary discussion of the principles of plant distribution followed by a detailed study of the forest regions of North America. Prerequisite: Course 21. Five credits. V, VI; MWF; G. MR. COOPER.
- 141.** PHYSICAL PHASES OF PLANT PHYSIOLOGY. The intake and translocation of materials, and the energy relations of the plant. Prerequisites: Course 22 and general organic chemistry. Five credits. I, II; MTWThF; G. MR. KNIGHT, MR. HARVEY.

- 142w. PLANT METABOLISM. The synthesis of plant food, its transformation and utilization by the plant. Prerequisites: Course 22 and general organic chemistry. Five credits. I, II; MTWThF; G. MR. KNIGHT.
- 143s. PLANT METABOLISM AND GROWTH. A continuation of Course 142, dealing with respiration, growth, and movement. Prerequisites: Course 22 and general organic chemistry. Five credits. I, II; MTWThF; G. MR. HARVEY, MR. KNIGHT.
- 144f or s. PLANT MICROCHEMISTRY. A study of the location of materials of physiological importance in the plant and their relation to physiological processes. Prerequisites: Course 22 and general organic chemistry. Five credits. Ar. Ar. G. MR. HARVEY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-202-203. RESEARCH PROBLEMS IN THE MORPHOLOGY OF VASCULAR PLANTS. MR. BUTTERS.
- 205-206-207. RESEARCH PROBLEMS IN THE TAXONOMY OF ANGIOSPERMS. MR. ROSENDAHL.
- 209-210-211. RESEARCH PROBLEMS IN ALGAE. MISS TILDEN.
- 213-214-215. RESEARCH PROBLEMS IN EMBRYOLOGY. MR. DURAND.
- 217-218-219. SPECIAL RESEARCH PROBLEMS IN THE TAXONOMY AND DISTRIBUTION OF ALGAE. MISS TILDEN.
- 221-222-223. RESEARCH PROBLEMS IN ECOLOGY. MR. COOPER.
224. RESEARCH METHODS IN PLANT PHYSIOLOGY. MR. KNIGHT, MR. HARVEY.
- 225-226-227. RESEARCH PROBLEMS IN PLANT PHYSIOLOGY. MR. KNIGHT, MR. HARVEY.
- 229-230-231. RESEARCH PROBLEMS IN CYTOLOGY. MR. ROSENDAHL.
- 233-234-235. SEMINAR. Students may register for one-hour seminar credit per quarter in any of the above research subjects.

CHEMISTRY

Professors PAUL H. M.-P. BRINTON, GEORGE B. FRANKFORTER, WILLIAM H. HUNTER, CHARLES A. MANN, CHARLES F. SIDENER; Associate Professors EVERHART P. HARDING, FRANK H. MACDOUGALL, M. CANNON SNEED; Assistant Professors LILLIAN COHEN, ISAAC W. GEIGER, LAWRENCE M. HENDERSON, GEORGE H. MONTILLON, LLOYD H. REYERSON, LEE I. SMITH.

Prerequisites.—

A. Chemistry as a major subject for the Doctor's degree. All candidates who choose chemistry as a major subject must offer the following courses or their equivalent as prerequisites: at least 12 quarter credits in general inorganic chemistry and qualitative analysis, at least 10 credits in quantitative analysis, and at least 10 credits in organic chemistry. All candidates must present at least one year in college physics or one year of college mathematics.

Each student who specializes in a particular branch of chemistry must complete certain advanced courses in connection with his choice. The completion of the course, however, does not satisfy the requirements made of the candidate for a higher degree; he must show a maturity acquired by intensive personal study of the literature and of the methods of chemistry.

B. Chemistry as a minor. It is not possible to state exactly those courses which will be required in each case. If the major is not chosen in chemistry, the usual prerequisites will be at least 12 credits of general inorganic chemistry and qualitative analysis and 5 credits of quantitative analysis or 5 credits of organic chemistry. The choice of the particular courses to be presented in fulfillment of the minor will be made after consultation with the head of the department in which the major work falls. Either Course 120-121 or Course 135-136-137 will be acceptable as a minor for the Master's degree, or for not more than one half of a minor for the Doctor's degree, if the student is not taking major work in chemistry.

Students choosing a branch of chemistry for their major work may choose physical chemistry for their minor work, but may not choose any other branch except by special permission of the group committee.

C. Candidates for the Master's degree must have a reading knowledge of German or French. A knowledge of German will be of more advantage to the candidate.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

GENERAL INORGANIC CHEMISTRY

101S. HISTORY OF CHEMISTRY. The theories of chemistry from the period of the ancients, with particular emphasis on modern theories and laws. Prerequisite: Course 36. Two credits. MISS COHEN.

102W. ADVANCED QUALITATIVE ANALYSIS. Includes an analysis of minerals, alloys, paints, and the methods of detecting some of the rarer elements. Prerequisite: Course 21. Two or three credits. MR. SNEED.

103f-104w-105S. ADVANCED INORGANIC CHEMISTRY. A discussion of valence, the periodic system and the chemistry of certain elements and their compounds and of special subjects of inorganic chemistry such as valency, oxidation and reduction, complex ions, etc. Prerequisites: Courses 21, 36. Three credits per quarter. Lect., D; TThS; III C. MR. SNEED.

ANALYTICAL CHEMISTRY

120W-121S. QUANTITATIVE ANALYSIS. General principles, methods, and procedure both gravimetric and volumetric. Typical problems; laboratory practice. Prerequisite: Course 13. Five credits per quarter. Lect. VI; M; 325C. Rec VI; F; 315C. VI-IX; MWF; 310C. MR. BRINTON, MR. SIDENER, MR. GEIGER, MR. SARVER.

123f. ADVANCED ANALYTICAL CHEMISTRY. Analytical methods for the determination of the common constituents of iron ore, iron, and steel are discussed and compared, with emphasis upon the general principles involved. Typical problems with laboratory practice. One lecture and seven laboratory hours per week. Prerequisite: Course 21 or 27 or 28. Three credits. Lect. VI; T; 315C. Lab. VII-IX; T; VI-IX; Th. MR. SIDENER, MR. GEIGER, MR. SARVER.

124W. ADVANCED ANALYTICAL CHEMISTRY. A survey of the methods of analytical chemistry applied to the analysis of minerals and ores. One lecture and 7 laboratory hours per week. Prerequisite: Course 21 or 123. Three credits. Lect. VI; T; 315C. Lab. VII-IX; T; VI-IX; Th. MR. BRINTON, MR. SIDENER, MR. GEIGER, MR. SARVER.

125S. ADVANCED ANALYTICAL CHEMISTRY. Selection may be made to meet the particular needs of the student from the following: silicate analysis, non-ferrous alloy analysis, water analysis, problems in electroanalysis, etc. One lecture and 7 laboratory hours per week. Prerequisite: Course 21 or 123. Three credits. Lect. VI; T; 315C. Lab. VII-IX; T; VI-IX; Th. MR. SIDENER, MR. SARVER.

127f-128W-129S. CHEMISTRY OF THE RARE ELEMENTS. Chemical relations and general reactions of rarer elements not considered in general courses. Analyses of commercially important ores and compounds of these elements are made. One lecture and 6 laboratory hours per week. Prerequisite: Course 21. Three credits per quarter. MR. BRINTON.

227f-228W-229S. SELECTED TOPICS IN ANALYTICAL CHEMISTRY. Analytical problems of an advanced nature presenting special difficulties will be selected for study and investigation in the laboratory, in the library, and by conference. Open only to graduate students who have had 18 credits of quantitative analysis, and who have a reading knowledge of French and German. Two, 3, or 4 credits per quarter. MR. BRINTON.

ORGANIC CHEMISTRY

131S. ORGANIC ANALYSIS. Practice in the identification of organic compounds, and the modern methods of qualitative organic analysis. Prerequisite: Course 37. Three credits. MR. LAUER.

133f. REAGENTS IN ORGANIC CHEMISTRY. Their limits of applicability, methods of use, and types of substances with which they react. May be accompanied by appropriate laboratory work in Chemistry 138. Prerequisite: Course 37. Three credits. MR. SMITH.

- 134w. THE TERPENES. Includes the bicyclic compounds and their important substitution products. May be accompanied by appropriate laboratory work in Chemistry 138. Prerequisite: Course 37. Two credits. MR. FRANKFORTER.
- 135f-136w-137s. ORGANIC CHEMISTRY. Full discussion of aliphatic and aromatic series with preparation of some of the more important compounds; other work of special nature will also be required. Offered to graduate students taking their minor in chemistry. Prerequisite: Course 13. Five credits per quarter. Lect III; MWF; 325C. Lab. VI-VIII; TTh; 390C. MR. HUNTER.
- 138f,w,s. ADVANCED ORGANIC CHEMISTRY LABORATORY WORK. Students may also register for this course who desire appropriate laboratory work for other advanced courses. Prerequisite: Course 37. Two to five credits. Lab. ar; 390C.
- 139f,w,s. ADVANCED ORGANIC CHEMISTRY LABORATORY WORK. An introduction to research work. These advanced laboratory courses may be taken under any member of the Division of Organic Chemistry. Prerequisite: Course 37. Two to five credits. Lab. ar; 390C.
- 191f-192w-193s. ADVANCED ORGANIC CHEMISTRY. An introduction to the literature of organic chemistry. Structure, reaction mechanism, and relation of physical properties to constitution. May be accompanied by appropriate laboratory work in Chemistry 138-139. Prerequisite: Course 131 or 133. Three credits per quarter. III; TThS; 325C. MR. HUNTER.
- 231f-232w-233s. ORGANIC CHEMISTRY SEMINAR. One hour a week. Open only to students taking research in organic chemistry. One credit. MR. HUNTER.

PHYSICAL CHEMISTRY

- 140f-141w-142s. PHYSICAL CHEMISTRY. A general survey of the subject. Three lectures and one recitation. Laboratory work three to six hours per week. Prerequisites: 2 years college dentistry, 1 year college physics. Three, four, or five credits, depending on the amount of laboratory work. Lect. IV; MWF. Rec. IV; S. Lab. VI-VIII; WF. MR. MACDOUGALL.
- 143f-144w-145s. THERMODYNAMICS AND CHEMISTRY. Prerequisites: Course 142 and calculus. Three credits per quarter. (Not offered in 1922-23.) MR. MACDOUGALL.
- 146f-147w-148s. KINETIC THEORY AND ATOMISTICS. Kinetic theory of gases and liquids, crystal structure, structure of atom, quantum theory. Prerequisites: Course 142 and calculus. Three credits per quarter. Lect. II; TThS. MR. MACDOUGALL.
- 149s. PRINCIPLES OF COLLOIDAL CHEMISTRY. Prerequisites: Course 141 and calculus. Two credits. MR. REYERSON.

- 150s. APPLICATION OF COLLOIDAL CHEMISTRY. Prerequisite: Course 141. Two credits. (Not offered in 1922-23.) MR. REYERSON.
- 151s. RADIOCHEMISTRY. The occurrence, methods of isolation, and physico-chemical properties of the radioactive substances, together with a brief consideration of the chemical, geological, and biological bearing of the subject. Prerequisite: Course 141. Two credits. MR. HENDERSON.
- 152f,w,s. LABORATORY COURSE IN RADIOCHEMISTRY. To accompany or follow Course 151. Credits arranged. MR. HENDERSON.
- 153f-154w-155s. ADVANCED PHYSICAL CHEMISTRY LABORATORY. To accompany or follow any of the advanced courses in physical chemistry. Prerequisite: Course 142. Credits arranged. MR. MACDOUGALL.
- 156w. APPLICATIONS OF PHYSICAL CHEMISTRY TO ORGANIC CHEMISTRY. Illustrations of the use of physicochemical methods in organic research. Prerequisites: Courses 130 and 142. Three credits. MR. HENDERSON.
- 241f-242w-243s. PHYSICAL CHEMISTRY SEMINAR. One hour a week. For students taking advanced courses in physical chemistry. One credit. MR. MACDOUGALL, MR. HENDERSON, MR. REYERSON.

TECHNOLOGICAL CHEMISTRY

- 161f-162w-163s. FOOD ANALYSIS. Prerequisite: Course 21. Three credits per quarter. Lect. II; F; 215C. Lab. VI-IX; F; I-II; W; 217C. MR. HARDING.
- 164w. EXACT GAS ANALYSIS. Prerequisite: Course 21. One or two credits. MR. HARDING.
- 166s. MICROCHEMISTRY. Chemical methods and the microscope applied to minute quantities of substances and the examination of food materials, fibers, etc. Prerequisite: Course 21. One or two credits. MR. HARDING.
- 167f. GAS AND FUEL ANALYSIS. The chemical analysis and colorimetry of solid and gaseous fuels and methods of testing municipal gas. Prerequisite: Course 21. Three credits. Lect. II; Th; 215C. I-III; TS; 217C. MR. HARDING.
- 168w. PETROLEUM AND PETROLEUM PRODUCTS. Examination and testing principally of gasoline, illuminating and lubricating oils. Prerequisite: Course 21. Three credits. Lect. II; Th; 215C. I-III; TS; 217C. MR. HARDING.
- 169s. GENERAL TECHNICAL ANALYSIS. Includes a large range of topics: textiles and paper, paints and varnishes, asphalt and tars, boiler waters, soaps, edible oils and fats, and various other food materials and food products. Prerequisite: Course 21. One, two, or three credits. Lect. II; Th; 215C. I-III; TS; 217C. MR. HARDING.

CHEMICAL ENGINEERING

- 171s. CHEMICAL MACHINERY. Principles and materials of construction, operation and uses of chemical machinery. Lectures and recitations. Laboratory work in operating and testing. Visits to chemical plants. Prerequisites: Courses 21, 36. Four credits. I; MTWThF; 111C. MR. MANN.
- 172f. INDUSTRIAL INORGANIC CHEMISTRY. Operations common to chemical industries, marketing of products, utilization of by-products, trade journals. Lectures and recitations. Prerequisite: Course 171. Four credits. I; MTWThF; 111C. MR. MANN.
- 173w. INDUSTRIAL ORGANIC CHEMISTRY. Similar to above but covering organic field. Lectures and recitations. Prerequisite: Course 172. Four credits. I; MTWThF; 111C. MR. MANN.
- 174f. CHEMICAL MANUFACTURE. (Inorganic.) Manufacture of technical products on a scale large enough to afford data for the determination of cost of manufacture. Use of semi-plant scale equipment and technical trade journals. Laboratory. Prerequisite: Course 171. Two or more credits. MR. MANN, MR. MONTILLON.
- 175w. CHEMICAL MANUFACTURE. (Organic.) Similar to above but covering the organic field. Laboratory. Prerequisite: Course 171. Two or more credits. MR. MANN, MR. MONTILLON.
- 176f-177w. APPLIED ELECTROCHEMISTRY. Application of the electric current to chemical processes. Laws and phenomena of electrochemistry, batteries, electroplating, electric furnace construction and operation, and electrolytic and electric furnace products. Prerequisite: Course 142. Four credits per quarter. Lect. III; MWF; 111C. Lab. VI-VIII; Th. MR. MANN, MR. MONTILLON.
- 178s. CHEMICAL ENGINEERING CALCULATIONS. Problems in drying, evaporation, filtration, and general chemical processes. Prerequisite: Course 173. Three credits. Lect. III; MWF; 111C. MR. MONTILLON.
- 179s. ADVANCED APPLIED ELECTROCHEMISTRY. The more recent developments in this field. Prerequisites: Courses 142, 176, 177. Four credits. MR. MANN, MR. MONTILLON.
- 180f-181w-182s. DESIGN OF CHEMICAL EQUIPMENT AND PLANTS. Based on collected data of the subject. Classroom and laboratory work. Prerequisite: Course 173. Two credits per quarter. VI-VIII; TF. MR. MANN, MR. MONTILLON.
- 183f. CHEMISTRY OF EXPLOSIVES. History, development, manufacture, and uses. Lectures, required reading, and reports. Prerequisite: Course 173. Four credits. MR. FRANKFORTER.
- 184s. ORGANIC DYESTUFFS. The technical chemistry of commercial dyes and their intermediates. Class and laboratory. Prerequisite: Course 173. Five credits. MR. FRANKFORTER.

- 185s. ADVANCED CHEMICAL MANUFACTURE. Problems in the manufacture of special chemicals on a large scale, using the industrial chemistry laboratory. Prerequisites: Courses 174, 175. Three credits. MR. MANN, MR. MONTILLON.
- 186s. GAS MANUFACTURE AND DISTRIBUTION. Three credits. MR. MONTILLON.
- 271f-272w-273s. SEMINAR. Presentation and discussion of papers concerning the newer developments in chemical industries. One credit. MR. MANN, MR. MONTILLON.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 301f-302w-303s. RESEARCH WORK IN INORGANIC CHEMISTRY. Credits to be arranged. MR. SNEED, MR. HENDERSON, MR. REYERSON.
- 321f-322w-323s. RESEARCH WORK IN QUANTITATIVE ANALYSIS. Credits to be arranged. MR. BRINTON, MR. SIDENER, MR. GEIGER.
- 331f-332w-333s. RESEARCH WORK IN ORGANIC CHEMISTRY. Credits to be arranged. MR. FRANKFORTER, MR. HUNTER, MR. SMITH.
- 341f-342w-343s. RESEARCH WORK IN PHYSICAL CHEMISTRY, INCLUDING WORK IN ELECTROCHEMISTRY, RADIOCHEMISTRY, AND COLLOIDS. Credits to be arranged. MR. MACDOUGALL, MR. HENDERSON, MR. REYERSON.
- 361f-362w-363s. RESEARCH WORK IN TECHNOLOGICAL CHEMISTRY. Credits to be arranged. MR. HARDING.
- 371f-372w-373s. RESEARCH WORK IN CHEMICAL ENGINEERING—INDUSTRIAL INORGANIC AND INDUSTRIAL ORGANIC CHEMISTRY—APPLIED ELECTROCHEMISTRY, ELECTRIC FURNACE WORK, AND CHEMICAL MANUFACTURE. Credits to be arranged. MR. FRANKFORTER, MR. MANN.

CIVIL ENGINEERING

Professors FREDERIC H. BASS, ALVIN S. CUTLER, FREDERICK M. MANN, JOHN I. PARCEL; Associate Professor FRANK B. ROWLEY; Assistant Professor GEORGE A. MANEY.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

For prerequisites see bulletin of College of Engineering and Architecture.

- 121f. RAILWAY ENGINEERING. Design and construction of railroad buildings and tracks. Method of computing earthwork, and estimates and reports. Three credits. MR. CUTLER.
- 122w. RAILWAY ENGINEERING. Train resistance, grades, curvature, distance, rise and fall, as factors in location and operation of railroads. Train-loading, acceleration, retardation; locomotives and equipment. Operating costs governing grade revision. Three credits. MR. CUTLER.

- 123s. RAILWAY ENGINEERING. Lectures, office work, and field inspection. Design and operations of various types of yards and terminals, and terminal facilities. Signalling and interlocking. Three credits. MR. CUTLER.
- 124w. TRANSPORTATION. Operating problems of railway, highway, ocean, and inland waterway transportation. Typical design and equipment. Cost and value of service, valuation, regulation, present systems, and organizations. Three credits. MR. CUTLER.
- 125s. TRANSPORTATION. Specific illustrative problems: Twin City and Mississippi Valley traffic situation, Mississippi River experiment, New York Barge Canal, Great Lakes traffic, St. Lawrence River project, Panama Canal status. Rapid transit, motor transport. Aerial transport. Three credits. MR. CUTLER.
- 131f. BRIDGE ANALYSIS. Stresses in simple span railway bridge trusses of the larger type. Four credits. MR. MANEY.
- 132w. BRIDGE DESIGN. Design and detail drawing of railway plate girder viaduct. Three credits. MR. MANEY.
- 133s. BRIDGE DESIGN. Complete design and detail drawing of railway pin truss span. Three credits. MR. MANEY.
- 134s. STATICALLY INDETERMINATE STRUCTURES. General theory deflections and statically indeterminate stresses and their application to continuous girders, frames, swing bridges, redundant members. Three credits. MR. PARCEL, MR. MANEY.
- 146f,w,s. CEMENT AND CONCRETE LABORATORY. Laboratory technique and experimental investigation of special problems in cement, concrete, and reinforced concrete. Three credits. MR. LAGAARD.
- 161f. HYDROLOGY. Rainfall, evaporation, transpiration, percolation, runoff. Flood and low water flows of streams. Storage problems. Three credits. MR. BASS.
- 162w. WATER SUPPLY ENGINEERING. Sources of supply. Laboratory methods of testing water; wells, surface water intakes, conduits and pipe lines, distribution systems, and purification plants. Selection of pumping machinery and motive power. Three credits. MR. BASS.
- 163s. SANITARY ENGINEERING. Quantities of sewage and storm water; precipitation and runoff. Sanitary sewer system for a small community; storm water system for a city district. Steam pollution and sewage disposal. Three credits. MR. BASS.
- 164w-165s. WATER POWER. Types of low, medium, and high head developments. Details of developments. Types of dams. Turbine settings and characteristics. Three credits. MR. BASS.

- 171f. BUILDING SANITATION. The location and orientation of buildings; lighting, ventilation, water supply, plumbing, sewage, and refuse disposal. Two credits. MR. BASS.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 221f-222w-223s. RAILWAY ADMINISTRATION. An analysis of railway organization and methods of management and operation. Principles of valuation and rate-making. Three credits. MR. CUTLER.
224. RAILWAY TERMINALS AND YARDS. A continuation of Course 123. Three credits. MR. CUTLER.
- 261s. WATER AND SEWAGE PURIFICATION. Continuation of Course 163. Design of water purification and sewage disposal. Three to five credits. MR. BASS.
262. WATER SUPPLY PROBLEMS. Continuation of Course 162. Three to five credits. MR. BASS.
- 251s. HIGHWAY LABORATORY. Investigation in coöperation with State Highway Department. Three to five credits. MR. LANG.
252. HIGHWAY ADMINISTRATION. Problems of highway administration and finance. Three to five credits. MR. LANG.
271. BUILDING SANITATION. A design course in the sanitation of buildings. Heating and ventilating, plumbing, lighting. Housing problems. Three to five credits. MR. BASS, MR. ROWLEY.
272. CITY-PLANNING. The physical elements of the city; topography, drainage, geology. Public works and structures. Street arrangements; rapid transit; railroad terminals. City-districting. Subsurface structures. Esthetic features of the city; the civic center; parks; boulevards; public buildings. Three to five credits. MR. BASS, MR. MANN.
- 234f-235w-236s. ADVANCED STRUCTURAL DESIGN. Fundamental theory of stresses applied to special problems. Relative economy in design. Comparative study of specifications. Three to five credits per quarter. MR. PARCEL.
- 237-238. STRUCTURAL LABORATORY. Similar to 234, but dealing mainly with experimental problems in structural steel. Strain gauge study of actual stress distribution in beams, columns, and riveted joints. Three to five credits per quarter. MR. MANEY, MR. LAGAARD.
- 245f-246w-247s. ADVANCED REINFORCED CONCRETE ANALYSIS. Critical review of the literature of reinforced concrete and study of the advanced theory. Study of test data and analysis of stresses in reinforced concrete structures. Three to five credits per quarter. MR. MANEY, MR. LAGAARD.

280f-281w-282s. CIVIL ENGINEERING RESEARCH. Original work along lines of plain and reinforced concrete, structural steel, hydraulics, municipal and transportation problems. Investigations, reports, tests, designs. Five credits per quarter. MR. BASS, MR. CUTLER, MR. PARCEL, MR. MANEY, MR. LAGAARD, MR. LANG.

COMPARATIVE LITERATURE

Professor OSCAR W. FIRKINS.

COURSES

- 101-102-103.† DRAMA. An outline of the history of drama, including the drama of to-day. Lectures and readings. III; TThS; 113F. MR. FIRKINS.
- 105-106-107.† PRINCIPLES OF CRITICISM. Lectures and readings. VI; MWF; 113F. MR. FIRKINS.
110. THE INTERNATIONAL ROMANTIC MOVEMENT IN EUROPE (1775-1825). II; TThS; 113F. MR. FIRKINS.
203. THE ARTHURIAN LEGEND: from Geoffrey of Monmouth to Tennyson and Wagner. MR. FIRKINS.
206. FRENCH AND ENGLISH LITERARY CRITICISM: from the sixteenth century to the present time. MR. FIRKINS.

COMPARATIVE PHILOLOGY

Professor FREDERICK KLAEBER; Assistant Professor SAMUEL KROESCH.

Prerequisites.—This department besides offering courses in the general principles of linguistic science, affords an opportunity for elementary studies in comparative Indo-European philology, and more particularly the investigation of Old German dialects. Related courses in English philology will be found under English Language and Literature.

As a matter of course, candidates for the Master's degree must have a knowledge of Latin and German; candidates for the Doctor's degree must have a knowledge of Greek also.

Students are advised to confer with the department before selecting courses.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f-102w. GENERAL INTRODUCTION TO THE SCIENCE OF LANGUAGE. Pre-requisite, one of the following groups: (1) five years' foreign language, four may be in high school and one in college; (2) two years' foreign language. Prerequisites same as for Course 101. Three credits. IV; 205F. MR. KLAEBER.

- 103f. UNIVERSAL LANGUAGE. Comparison of families of languages grammatically and lexically. Movement for creation of an international language. Prerequisites same as for Course 101. Three credits. IV; TS; 205F. MR. KLAEBER.
- 105s. THE LIFE OF WORDS. Etymology, and semasiology. Growth of vocabulary; change of words in form and meaning. Prerequisites same as for Course 101. Three credits. VI; TTh; 205F. MR. KLAEBER.
- 108f. COMPARATIVE PHONETICS. A study of speech sounds and the nature of their production with especial reference to English, French, and German. Open to students of the modern languages. Prerequisites: 2 credits in other than elementary courses. This course is identical with German 108. Three credits. Hours to be arranged. MR. KROESCH.
- 109f-110W-111s. HISTORY OF THE GERMAN LANGUAGE. Identical with German 109-110-111. Nine credits. (Not offered in 1922-23.) MR. KLAEBER.
- 141f-142W-143s. HISTORICAL GRAMMAR OF THE ENGLISH LANGUAGE. I. Sounds and spelling. II. Accidence and syntax. Nine credits. (Not offered in 1922-23.) MR. KLAEBER.

COURSES PRIMARILY FOR GRADUATE STUDENTS

202. COMPARATIVE GRAMMAR OF THE GREEK, LATIN, AND GERMANIC LANGUAGES. A general survey of the field of Indo-Germanic philology will be particularly emphasized. Study of the grammar, reading of texts.
- 203-204. GOTHIC. The relation of Gothic to other Germanic dialects will be particularly emphasized. Study of the grammar, reading of texts, discussion of problems. MR. KLAEBER.
205. URGERMANISCHE GRAMMATIK. Lectures and study of standard works. MR. KLAEBER.
206. COMPARATIVE PHONOLOGY OF ENGLISH AND GERMAN. Elements of phonetics; history of English and German sounds; orthography. MR. KLAEBER.
- 207-208. OLD SAXON. Old Saxon grammar; interpretation of the *Heliand* and *Genesis*. MR. KLAEBER.
- 209-210. OLD HIGH GERMAN. Braune's *Althochdeutsche Grammatik*; Braune's *Althochdeutsches Lesebuch*. This course is identical with German 209-210. MR. KLAEBER.
- 211-212. RESEARCH SEMINAR. Competent graduate students will be advised and assisted in research along special lines. MR. KLAEBER.

DAIRY HUSBANDRY

Professors CLARENCE H. ECKLES, JOSEPH R. KEITHLEY; Assistant Professor ALLAN B. RAYBURN.

Students taking their major in dairy husbandry may be exempted from the language requirements for the Master's degree.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f. MILK PRODUCTION. Problems of the dairy farmer with laboratory work. IV; MTWF; 40DH. MR. ECKLES.
- 102s. MARKET MILK. Lectures and laboratory work. VI, VII; MWF; 39DH. MR. KEITHLEY.
- 103w. DAIRY STOCK-FEEDING. Application of the principles of nutrition to special problems of feeding the dairy cow and growing the young animals. III; MWF; 30DH. MR. ECKLES.
- 104f. ADVANCED STUDY OF DAIRY BREEDS. Practice in comparative judging; selection and valuation; visits to purebred herds. III; S; V, VI; TTh; 40DH. MR. RAYBURN.
- 105f-106w-107s. SEMINAR. Special investigation and study of selected topics. Reports on assigned subjects and reviews recent scientific investigations. II; S; 30DH. MR. ECKLES.
- 111f. DAIRY PRODUCTS I. The chemical, bacteriologic and economic problems in the manufacture and marketing of butter and ice cream. Laboratory exercises. I; MW; II, III; Th; 39DH. MR. KEITHLEY.
- 112s. DAIRY PRODUCTS II. Similar to 111f with special application to cheese, condensed milk, and milk powder. Laboratory exercises. IV; TF; V, VI; T; 39DH. MR. KEITHLEY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 202f-203w-204s. RESEARCH IN DAIRY HUSBANDRY. Facilities offered for study and investigation of subjects pertaining to dairy cattle. Students are allowed to assist at times with investigations under way in the experiment station. Arranged to meet the needs of individual student. 30DH. MR. ECKLES.
- 205f-206w-207s. DAIRY PRODUCTS. Opportunity and facilities are offered for the study and investigation of problems concerning common dairy products. The work is arranged to meet the needs of the individual student. MR. KEITHLEY.

ECONOMICS

Professors GEORGE W. DOWRIE, JOHN D. BLACK, ROY G. BLAKEY,¹ FREDERIC B. GARVER, NORMAN S. B. GRAS; Associate Professors ALVIN H. HANSEN, BRUCE D. MUDGETT, CLARE L. ROTZEL; Assistant Professors

¹ Absent on leave, 1922-23.

Z. CLARK DICKINSON, ERNEST A. HEILMAN, HOWARD S. NOBLE, H. BRUCE PRICE, JOHN J. REIGHARD, J. WARREN STEHMAN, HOLBROOK WORKING; Professorial Lecturer J. FRANKLIN EBERSOLE.

Candidates for higher degrees will be accepted as majors in economics in the following fields: money and banking, public finance, economic theory, economic history, labor statistics, agricultural economics; marketing, land economics, farm finance, economics of agricultural production, agricultural prices.

GENERAL ECONOMICS

Prerequisites.—For major work, 27 quarter credits for those offering Economics 1-2, or Economics 20-21, or their equivalent; 18 quarter credits for those not presenting one of these courses or an equivalent. These credits should include Money and Banking, Statistics, and Accounting. Candidates not presenting these fundamental courses upon registration in the Graduate School may be required to complete them in addition to the regular course requirements for the degree.

Majors and minors.—Major and minor work for the Master's degree may both be taken in economics if the candidate presents a program of courses properly complementing each other and not too closely related, if approved by the Executive Committee of the Graduate School. Agricultural economics and economic history will usually be considered satisfactory as majors or minors distinct from general economics.

Required courses.—All candidates for the Master's degree must complete Economics 103-104, or Economics 203-204-205, or the equivalent of either. Other courses will be required according to the field in which the candidate is working. Ordinarily at least one full graduate seminar must be carried throughout the year.

Language requirement.—Candidates for the Master's degree in economics are required to have a reading knowledge of a foreign language only when the thesis is written in the following fields: money and banking, public finance, economic theory, economic history, and labor.

AGRICULTURAL ECONOMICS

Prerequisites.—For major work 18 quarter credits. If, however, these credits do not include courses in Money and Banking, Statistics, and Accounting, these may be required in addition to the regular course requirements for the degree. Farm Management II and III may be included as economics prerequisites.

Majors and minors.—Upon approval of the graduate faculty, candidates doing their graduate work in agricultural economics may take their minor in general economics.

Language requirements.—Candidates for the Master's degree in agricultural economics must have a reading knowledge of a foreign language only when the thesis is in land economics or farm finance.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 103f-104w. VALUE AND DISTRIBUTION. Six credits. VII; MWF; 102MA. MR. GARVER, MR. WORKING.
- 105s. HISTORY OF ECONOMIC IDEAS. Three credits. VII; MWF; 102MA. MR. GARVER.
- 112f. BUSINESS STATISTICS. Three credits. II; TThS; 202MA. MR. MUDGETT.
- 113w. THEORY OF STATISTICS. Three credits. II; TThS; 213MA. MR. MUDGETT.
- 117w.* PRICES OF FARM PRODUCTS. Three credits. II; TThS. MR. WORKING.
- 118f-119w-120s. ECONOMIC HISTORY OF EUROPE AND THE UNITED STATES, 1750 TO THE PRESENT. (See History 113-114-115.)
- 121f-122w-123s. ECONOMIC HISTORY OF EUROPE, 1300-1750. (See History 116-117-118.)
- 131f-132w-133s. COST ACCOUNTING. Nine credits. (1) II; TThS; 109MA. (2) III; TThS; 109MA. MR. NOBLE.
- 135w-136s. AUDITING. Four credits. II; MWF; 209MA. MR. REIGHARD.
- 134f. INCOME TAX ACCOUNTING. Two credits. II; MWF; 202MA. MR. REIGHARD.
- 137f-138w-139s. ACCOUNTING PRACTICE AND PROCEDURE. Nine credits. (1) III; MWF; 109MA. (2) IV; MWF; 102MA. MR. HEILMAN.
- 143f-144w, 143w-144s. THE FINANCIAL SYSTEM. Eight credits. Fall to winter. Lect. IV; T. (1) VIII; MTW; 209MA. (2) II; MWF; 109MA. (3) III; MWF; 202MA. (4) II; TThS; 311F. (5) III; TThS; 209MA. (6) VI; MWF; 209MA. (7) III; MWF; 302D. (8) II; MWF; 110F. Winter to spring. IV; MWFS. MR. DOWRIE and others.
- 145s. FOREIGN EXCHANGE. Three credits. II; TThS; 102MA. MR. DOWRIE.
- 146f. INVESTMENTS. Three credits. IX; MTW; 209MA. MR. EBERSOLE.
- 147s. BANK ADMINISTRATION. Three credits. IX; MTW; 209MA. MR. EBERSOLE.
- 149w,s. BUSINESS CYCLES. American business conditions since 1890 with regard to the great cycles of alternate prosperity and depression, and financial panics. Critical examination of all the available business barometers designed to forecast similar conditions. Three credits. IX; MTW; 209MA. MR. EBERSOLE.

* Given at the University Farm.

- 150s.* ADVANCED FARM FINANCE. Three credits. MR. DOWRIE.
- 153w. THE TRUST PROBLEM. Three credits. II; MWF; 213MA. MR. NELSON.
- 154s. PUBLIC UTILITIES. Three credits. MWF; 102MA. MR. REIGHARD.
- 155s. CORPORATION FINANCE. Lect. III; S. LitTh. (1) II; TTh; 109MA. (2) III; TTh; 102MA. (3) III; MW; 202MA. (4) IV; MW; 209MA. (5) VI; TTh; 213MA. (6) VII; TTh; 102MA. MR. STEHMAN.
- 156f. ADVANCED CORPORATION FINANCE. II; TThS; 213MA. MR. STEHMAN.
- 160s. ECONOMIC MOTIVES. Psychological approach to certain problems of economic theory. Three credits. VII; MWF; 202MA. MR. DICKINSON.
- 161f,w. LABOR PROBLEMS AND TRADE UNIONISM. Three credits. Fall. Lect. IV; MW; 202MA. (1) IV; F; 202MA. (2) IV; F; 209MA. (3) IV; T; 102MA. Winter. III; TThS; 302D. MR. HANSEN.
- 162w. THE LABOR MOVEMENT IN AMERICA AND ENGLAND. Three credits. IV; MWF; 202MA. MR. HANSEN.
- 167w. INDUSTRIAL RELATIONS. Principles of labor administration for various types of organization and workers. Job analysis, wages, stability of work, joint relations. Three credits. II; TThS; 209MA. MR. DICKINSON.
- 168s. PERSONNEL MANAGEMENT. Problems and methods as to employment, promotion, training, health, safety, hours, working conditions, and employees' service. Three credits. II; TThS; 209MA. MR. DICKINSON.
- 169s. THE LABOR AND SOCIALIST MOVEMENT IN EUROPE. Three credits. IV; MWF; 202MA. MR. HANSEN.
- 176f,s. COMMERCIAL POLICIES. Theory of international commerce; free trade, reciprocity, subsidies, preferential treatment, the open door, international finance, commercial treaties, foreign politics, and other governmental and organized efforts to affect trade. American problems emphasized. Three credits. I; MWF; 202MA.
- 177w. FOREIGN TRADE. Three credits. I; MWF; 202MA.
- 180f-181w-182s. SEMINARS FOR SENIORS AND GRADUATES. Intensive study of problems in respective fields of specialization. In 1922-23 seminars will be offered in the following:

* Given at the University Farm.

No.	Title	Hour	Day	Building
A.	Accounting	V½-VI	TTh	301MA
B.	Business Finance.....	VIII	MWF	213MA
C.	Marketing	VII-VIII½	TTh	213MA
E.	Industrial Relations	Ar	Ar	Ar
F.	Statistics	Ar	Ar	Ar
G.	Marketing of Farm Products.....	Ar	Ar	Ar
D.	Labor	Ar	Ar	Ar
H.	Prices of Farm Products.....	Ar	Ar	Ar

191f-192w. PUBLIC FINANCE. Six credits. III; MWF; 209MA.

193s. STATE AND LOCAL TAXATION. Three credits. III; MWF; 209MA.

COURSES PRIMARILY FOR GRADUATE STUDENTS

203f-204w-205s. SEMINAR IN ECONOMIC THEORY. Intensive study of a limited field in economic theory. Individual investigation, reports, and group discussion. The topic for 1922-23 will be in the theory of value. Nine credits. VIII½-IX; TTh; 104MA. MR. GARVER.

210f-211w-212s. SEMINAR IN ECONOMIC HISTORY. (See Department of History.)

106w. LAND ECONOMICS. Land as a factor of production; rural and urban land utilization; rents and land values; land classification; land exchange. Three credits. VII; MWF. MR. BLACK.

106s. LAND ECONOMICS. Three credits. VII-VIII½; TTh. MR. BLACK.

107s. LAND TENURE. Property in land; tenancy; farm labor; evolution of the tenure classes. Three credits. VII; MWF. MR. BLACK.

108w. MARKETING OF FARM PRODUCTS. Three credits. I; TThS. MR. PRICE.

110s-111f. PRACTICE COURSE IN MARKETING. Eight to twelve weeks of experience as an employee in central or local markets. Careful study and observation of methods. Written plans and reports. Three credits. To be arranged. MR. PRICE.

116f. ECONOMICS OF AGRICULTURAL PRODUCTION. Three credits. I; TThS. MR. BLACK.

116w. ECONOMICS OF AGRICULTURAL PRODUCTION. Three credits. III; TThS. MR. BLACK.

126f. PRINCIPLES OF COÖPERATION. Three credits. III; MWF. MR. BLACK, MR. MILLER.

127w-128s. MARKETING ORGANIZATION AND MANAGEMENT. Principles of accounting and business organization applied to the organization and management of proprietary and coöperative marketing business units. six credits. III; MWF. MR. BLACK.

219f-220w-221s. SEMINAR IN AGRICULTURAL ECONOMICS. Topics and hours to be arranged. MR. BLACK.

EDUCATION

Professors MELVIN E. HAGGERTY, LEONARD V. KOOS, WILFORD STANTON MILLER, MERVIN GORDON NEALE, ASHLEY V. STORM, FLETCHER H. SWIFT; Assistant Professors ALBERT M. FIELD, ROSS L. FINNEY, MARVIN J. VAN WAGENEN; Professorial Lecturer FREDERICK KUHLMANN.

Prerequisites.—For major work, at least 6 quarter credits in psychology and in addition to this a total of not less than 18 quarter credits of undergraduate work in education.

Exemption from the language requirement for the Master's degree may be made in individual cases.

Departmental conferences.—Every alternate Monday all graduate students majoring in education are expected to meet with the departmental staff from 7:30 to 9:00 p.m. for conference regarding subjects of original investigation. This work carries no credit.

NOTE.—Candidates for the University state teacher's certificate may offer Course 101, 102, or 103 in place of Education I.

SUGGESTED COURSE FOR ALL CANDIDATES FOR DEGREES

208w. METHODS OF EDUCATIONAL RESEARCH. Suggested for all candidates for degrees. Two credits. III, IV; S; 113Ed. MR. SWIFT.

EDUCATIONAL ADMINISTRATION

113f-114w. HIGH SCHOOL CURRICULUM. Four credits. III, IV; S. MR. KOOS.

113s. HIGH SCHOOL CURRICULUM. Three credits. II; TThS, MR. KOOS.

119w. ELEMENTARY SCHOOL CURRICULUM. Prerequisites: Education I and 3. Three credits. I; MWF. Ar. MR. NEALE.

119Tf-120Tw. ELEMENTARY SCHOOL CURRICULUM. (Same as above for teachers.) Two credits. I, II; S; 113Ed. MR. NEALE.

123s. SUPERVISION OF HIGH SCHOOL INSTRUCTION. A course combining consideration of principles and their application to improving high school instruction in the academic and special subjects. Prerequisites: 10 hours in education. Three credits. III; MWF; ar.

124f. EDUCATIONAL ADMINISTRATION. The organization and administration of state and city school systems with interpretations. Three credits. IX; MWF; 205Ed. MR. NEALE.

125w-126s. CITY SCHOOL ADMINISTRATION. For superintendents and principals. Prerequisite: Education 124. Six credits. III, IX; MWF; 205Ed.

- 160f-161w-162s. THEORY OF SUPERVISION. Purpose, technique, conditions, and testing of supervision. Prerequisites: Education 11 or equivalent. Six credits. III, IV; S; ar.
- 164w. PROBLEMS OF HIGH SCHOOL ADMINISTRATION. Prerequisites: Education 1 and 3. Three credits. III; TThS. MR. KOOS.
- 167f. JUNIOR HIGH SCHOOL. A study of the special purposes of this institution and the appropriate reorganizations to achieve them; the history of the movement. Prerequisites: Education 1 and 3. Three credits. II; TThS. MR. KOOS.
- 167w-168s. JUNIOR HIGH SCHOOL. (Same as above.) Prerequisites: Education 1 and 3. Four credits. IX, X; Th; 102Ed. MR. KOOS.
- 173w. CITY SCHOOL FINANCE, PART I. A study of municipal school funds and their expenditure with special reference to their relations to other municipal funds and costs. Three credits. VII; MWF. MR. SWIFT.
- 174f. PUBLIC SCHOOL FINANCE. A critical study of problems of federal and state aid to public schools. Students are strongly advised to take as preparation or in conjunction with this course Economics 191f-192w Public Finance, and Education 126f-127w Methods of Educational Research. Two credits. VII; TTh; 205Ed. MR. SWIFT.
- 175s. CITY SCHOOL FINANCE. Analysis of unit costs on various bases; comparative cost accounting systems, budgets, financial records, and reports. Three credits. VII; MWF; ar. MR. NEALE.
- 178f-179w. SCHOOL SURVEYS. Literature and methods of school surveys. Six credits. VIII; MWF. MR. NEALE.
- 205f-206w-207s. SEMINAR IN EDUCATIONAL ADMINISTRATION. Prerequisites: Education 124, 125-126, 160-161-162. Ar.; 111Ed. MR. NEALE.
- 215f-216w-217s. SEMINAR IN PUBLIC EDUCATION IN THE UNITED STATES. The following may be considered typical problems: school support, school supervision, administration units. Prerequisites: Education 1 or 101-102-103 and 3. Six credits. IX, X; W. MR. SWIFT.
- 218f-219w-220s. SEMINAR IN SECONDARY SCHOOL PROBLEMS. Six credits. Ar.; 111Ed. MR. KOOS.

EDUCATIONAL PSYCHOLOGY

- 106f-107w-108s. ADVANCED EDUCATIONAL PSYCHOLOGY. Advanced work in genetic psychology, origin and nature of human organism, development and control of instincts. Methods of measuring rate of learning; typical learning experiments. Group and individual differences, and their relations to educational practice. Prerequisite: Education 55 or equivalent. Nine credits. III; MWF. MR. VAN WAGENEN.

- 111S. EDUCATIONAL DIAGNOSIS. The typical educational problems involving the nature and use of educational scales, standard tests, and programs of remedial educational procedure based on the results of the test. Prerequisite: Education 55 or equivalent. Three credits. II; MWF. MR. VAN WAGENEN.
- 111Tf-112Tw. EDUCATIONAL DIAGNOSIS. (Same as above for teachers.) Four credits. I, II; S. MR. VAN WAGENEN.
- 126f. STATISTICAL METHODS. This course is ordinarily required of all candidates for advanced degrees. Two credits. IX, X; T. MR. VAN WAGENEN.
- 127W-128S. ADVANCED STATISTICAL METHODS. Prerequisite: Education 126. Four credits. IX, X; T. MR. VAN WAGENEN.
- 134f-135W-136S. MENTAL TESTS AND MENTAL DIAGNOSIS. A laboratory course in the study of individual differences by means of mental tests. Methods of treating superior and subnormal children. Prerequisite: Education 55 or equivalent. Six credits. VII, VIII; MW. MR. MILLER.
- 143-144-145. INDIVIDUAL MENTAL EXAMINATION. For teachers of subnormal children. Demonstration and practice in mental diagnosis. Prerequisite: Education 55 or equivalent. Six credits. I, II; S. MR. KUHLMANN.
- 138W-139S. EXPERIMENTAL EDUCATION. A laboratory course in the use of experimental methods, particularly in the field of the psychology of learning. Prerequisite: Education 55 or equivalent. Four credits. IX, X; MW. (Not offered in 1922-23.)
- 149f-150W-151S. PSYCHO-EDUCATIONAL CLINIC. Conducted in coöperation with the Department of Sociology and the Medical School clinics in pediatrics and nervous and mental diseases. Students will receive systematic instruction in giving psychological examinations and in scientific interpretation of data. Prerequisite: Education 134-135-136. Three to 9 credits. II:30-1:30; MWF; Millard Hall.
- 146f-147W-148S. PRACTICE COURSE IN MENTAL EXAMINATION. For teachers of subnormal children. Conducted in coöperation with the public schools. Results studied in relation to medical and school data. Prerequisite: Education 134-135-136. Three credits. Ar. MR. KUHLMANN.
- 153f-154W-155S. RESEARCH PROBLEMS IN EDUCATIONAL PSYCHOLOGY. Prerequisites: Advanced courses necessary to pursue problems. Consult instructor. Credits and hours arranged. MR. HAGGERTY, MR. MILLER, MR. VAN WAGENEN, MR. KUHLMANN.
- 156S. PSYCHOLOGY OF VOCATIONAL EDUCATION. Attention given to matters of personnel, acquisition of skill, motivation of workers, and efficiency of administration. Prerequisite: Education 55 or equivalent. Two credits. I, II; S; Psy.

184f-185w-186s. MENTAL DEFICIENCY. Survey of mental deficiency in children and adults. Physical traits including study of brain defects, causes and heredity; psychology of mental deficiency; social problems of feeble-mindedness. Subject treated with reference to the training of defectives. Prerequisite: Education 55 or equivalent. Six credits. III, IV; S. MR. KUHLMANN.

197f-198w-199s. SEMINAR: PROBLEMS OF SUBNORMALITY. Review of the important literature and original investigation. Two credits. IX, X; F. MR. KUHLMANN.

201f-202w-203s. SEMINAR IN EDUCATIONAL PSYCHOLOGY. A research course for graduate students. Required of all students writing theses in educational psychology. Six credits. IX-X; M; 203Ed. MR. HAGGERTY.

HISTORY OF EDUCATION

101f. FOUNDATIONS OF MODERN EDUCATION. Emphasizes the more important elements in modern education derived from the Hebrews, Greeks, Romans, Middle Ages, and Renaissance. Prerequisites: psychology, 6 credits and 6 credits in the Department of History. Three credits. VIII; MWF; 205Ed. MR. SWIFT.

102w. HISTORY OF MODERN SECONDARY AND HIGHER EDUCATION IN EUROPE AND AMERICA. Prerequisites: psychology, 6 credits and 6 credits in the Department of History. Three credits. VIII; MWF; 205Ed. MR. SWIFT.

103s. HISTORY OF MODERN ELEMENTARY EDUCATION. Emphasis upon the rise of state systems and upon the history of modern educational reform. Prerequisites: same as for Courses 101 and 102. Three credits. VII; MWF; 205Ed. MR. SWIFT.

129w-130s. EDUCATIONAL CLASSICS. Prerequisite: Education 1 or 101-102-103. Six credits. VII; MWF; 205Ed. (Not offered 1922-23.) MR. SWIFT, MISS ALEXANDER.

131w-132s. COMPARATIVE SCHOOL SYSTEMS. A survey of the existing school systems of France, England, Germany, Denmark, with special reference to educational conditions in the United States. Prerequisite: Education 1 or 101-102-103. Six credits. III; MWF; 102Ed. MISS ALEXANDER.

187f-188w-189s. SEMINAR IN EDUCATIONAL SOCIOLOGY. The selection of problems to be determined in part by the student's interest. Prerequisites: Education 1 or 101, 102, 103 and 3. Six credits. I, II; S. AR. MR. FINNEY.

211-212-213. SEMINAR IN HISTORY OF EDUCATION. Problems to be selected somewhat upon the basis of students' interest. Prerequisites: Education 101-102-103 or its equivalent and 6 credits in the Department of History. Six credits. IX, X; F. MR. SWIFT.

TRADE AND INDUSTRIAL EDUCATION

V169s. PRINCIPLES OF PART-TIME EDUCATION. A study of problems of the new movement for part-time schools as outlined in the Smith-Hughes Law. Social and economic backgrounds of the part-time school, methods of organizing classes, a study of special student groups, and courses of study. Prerequisites: 15 credits in education. Two credits. I, II; S. 202Ed.

V170f-171W-172s. ADMINISTRATION OF VOCATIONAL EDUCATION. An intensive study of the Smith-Hughes Law, methods, practices, and policies of the Federal Board of Vocational Education. Prerequisite: 15 credits in education. Six credits. III, IV; S; 202Ed.

V176f-177W-178s. PROBLEMS IN VOCATIONAL EDUCATION. Among these are: the attitude of labor toward vocational education; industrial education for women and girls; the new dual system; industrial rehabilitation. Prerequisite: 15 credits in education. Six credits. IX, X; Th; 205Ed.

V191W-192s. PRINCIPLES OF VOCATIONAL AND INDUSTRIAL EDUCATION. Prerequisite: 15 credits in education. Six credits. IX, X; T; 205Ed.

HOME ECONOMICS EDUCATION

141. PROBLEMS IN HOME ECONOMICS EDUCATION. Prerequisites: Home Economics 42, Education 55. Three credits. Ar. MISS CLARA BROWN.

AGRICULTURAL EDUCATION

Prerequisites.—For major or minor work, 18 credits in agricultural education and preparation in agricultural subjects satisfactory to the Department of Agricultural Education.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

131f,w,s. METHODS IN TEACHING HIGH SCHOOL AGRICULTURE. Five credits. MR. FIELD.

151W,s. ORGANIZATION AND MANAGEMENT. Organization and management of work in secondary schools, particularly of Minnesota, with special reference to agricultural work, courses of study, programs, equipment, laboratory and class management, extension work, plots, and coördination of work. Five credits. MR. STORM, MR. DYER.

153f,s. CONSOLIDATED RURAL SCHOOLS. To prepare principals to meet the problems peculiar to consolidated rural schools. Three credits. MR. DYER.

154f,w. RURAL EDUCATION AND COMMUNITY LIFE. The rural school as a community center for educational, social, and recreational work. Three credits. MR. DYER.

- 161f-162w-163s. FUNDAMENTALS OF AGRICULTURE. Essential for principals and superintendents of schools in which agriculture is taught. Agricultural college experts will give work in their special fields. Nine credits. MR. STORM.
- 176s. ADVANCED VISUAL PRESENTATION. Based on Course 75. Further work in design and construction of charts and lantern slides. Special study of motion picture machines. Actual practice in effective use of visual aids in lecture and recitation. Three credits.
- 191f-192w-193s. SEMINAR IN AGRICULTURAL EDUCATION. Individual investigation and research; review and interpretation of current educational literature. Two credits each. MR. STORM, MR. FIELD.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f-202w-203s. ADVANCED SEMINAR. Study of the broader administrative problems and policies in the field of agricultural education. Opportunity for independent investigation and research. One to 2 credits per quarter. 209Ad(F). MR. STORM, MR. FIELD.
- 221f-222w-223s. GRADUATE PROBLEMS. Making investigations, gathering data, and formulating plans regarding agricultural education. Three credits. 209Ad(F). MR. STORM, MR. DYER, MR. FIELD.
- Agri.Educ.241f. OPERATION OF VOCATIONAL AGRICULTURE. Problems involved in the state and local activities in conducting vocational agriculture. It includes a study of federal and state laws and regulations, courses of study, duties of the state supervisor, reports, records, and conferences. Two credits. MR. STORM, MR. FIELD.
- Agri.Educ.242w, 243s. ORGANIZATION AND ADMINISTRATION OF TEACHER-TRAINING FOR VOCATIONAL AGRICULTURE. Development of teacher-training institutions, agricultural college curricula, professional needs of high school teachers, professional courses and their content, equipment, itinerant teacher-training, practice teaching, teacher evaluation. MR. STORM, MR. FIELD.

ELECTRICAL ENGINEERING

Professors GEORGE D. SHEPARDSON, FRANK W. SPRINGER; Associate Professor WILLIAM T. RYAN.

Prerequisites.—For major work, 12 credits in the department; for minor work, 6 credits in physics.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 111f-113w-115s. ELECTRICAL MACHINERY. Prerequisite: one year in physics. three credits per quarter. 9:30; MWF. MR. SPRINGER.
- 112f-114w-116s. ELECTRICAL MACHINERY LABORATORY. To be taken with Course 111-113-115. Lectures and practice. Prerequisite: Physics 41-42. Two credits per quarter. MR. SPRINGER, MR. MARTIN.

- 121f-123W-125s. ALTERNATING CURRENTS. Prerequisite: Electrical Engineering 115. Three credits per quarter. 10:30 or 11:30; MWF. (Two sections.) MR. RYAN.
- 122f-124W-126s. ALTERNATING CURRENT LABORATORY. To be taken with Course 121-123-125. Prerequisite: Electrical Engineering 116. Two credits per quarter. MR. SPRINGER.
- 132f-134W-136s. ELECTRICAL DESIGN. Prerequisite: Electrical Engineering 115. To be taken with Course 121-123-125. Two credits per quarter. MR. KUHLMANN.
- 141f. CENTRAL STATIONS. Operation, design, and construction of electric power generating stations. Prerequisite: Electrical Engineering 115. Two credits. MR. RYAN.
- 142W. ELECTRICAL TRANSPORTATION. Prerequisite: Electrical Engineering 141. Two credits. MR. RYAN.
- 144W. RAILWAY ELECTRICAL ENGINEERING. Prerequisite: Electrical Engineering 115 or 45. Two credits. MR. MARTIN.
- 145s. STEAM RAILROAD ELECTRIFICATION. Prerequisite: Electrical Engineering 144. Two credits. MR. MARTIN.
- 151f. ELECTRIC LIGHTING. Lectures, problems, and laboratory practice. Prerequisite: one year in physics. One credit. MR. MARTIN.
- 152f. PHOTOMETRIC LABORATORY. Photometric studies of incandescent and arc electric lamps, gas and oil lamps. Bench and radial photometers and illuminometers. To be taken with Electrical Engineering 151. One credit. MR. MARTIN.
- 161f. RADIO COMMUNICATION. Phase relations in high frequency circuits. Mathematical theory of damped wave transmission and receiving circuits. Inductance and capacity measurements using damped waves. The electron tube as a detector and amplifier. Signal Corps apparatus. Prerequisite: registration in Electrical Engineering 121. Three credits. MR. JANSKY.
- 162W. RADIO COMMUNICATION. Theory and measurement of logarithmic decrement. Undamped wave transmitting and receiving circuits. Heterodyne reception. The arc, high frequency generator, and electron tube as sources of high frequency power. High frequency measurements, using undamped waves. Prerequisite: Electrical Engineering 161. Three credits. MR. JANSKY.
- 163s. RADIO COMMUNICATION. Mathematical theory of the electron tube and its use in the radio circuit. Design of electron tube oscillator and amplifier circuits. Radio telephony, modulation, carrier frequencies. Direction-finding apparatus and selective circuits for interference elimination. Prerequisite: Electrical Engineering 162. Three credits. MR. JANSKY.

- 164f. TELEGRAPH AND TELEPHONE APPARATUS. Theoretical and experimental study of apparatus used for signaling, telegraphy, and telephony. Lectures and laboratory. Prerequisite: to be taken with Course 121. Two credits. MR. SHEPARDSON, MR. SWENSON.
- 165W-166S. TELEGRAPH AND TELEPHONE CIRCUITS. Theoretical and experimental study of telegraph and telephone circuits and the phenomena of long line transmission. Prerequisite: Course 164. Two credits per quarter. MR. SHEPARDSON.
- 167f-168W-169S. RADIO STATION OPERATION. For men already proficient, licensed radio operators. Open only to a limited number by permission. One credit per quarter. MR. JANSKY.
- 183f-184W-185S. ELECTRICAL LABORATORY. Efficiency tests and special problems. Prerequisite: Electrical Engineering 126. Credits as arranged. MR. SHEPARDSON, MR. SPRINGER.
- 186W or S. HIGH TENSION-TESTING. Low frequency pressure up to 320,000 volts and high frequency to several million volts applied to the study of dielectric phenomena, testing of high tension transmission, etc. Prerequisite: Electrical Engineering 124. Two credits. MR. SPRINGER.
- 191f-192W-193S. JOURNAL-READING. Weekly discussion of current electrical periodicals. Prerequisite: Electrical Engineering 115 or equivalent. No graduate credit. MR. SHEPARDSON.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 221f. TRANSIENT ELECTRICAL PHENOMENA. Mathematical study of the electric circuit containing resistance, inductance, and capacity. Abnormal currents and voltage upon switching circuits containing iron core inductances. Prerequisite: Electrical Engineering 121. Two credits. MR. JANSKY.
- 223W. TRANSIENT ELECTRICAL PHENOMENA. Current and voltage distribution in circuits containing distributed resistance, inductance, and capacity. Distortion in telephone lines and its correction. Prerequisites: Electrical Engineering 221. Two credits. MR. JANSKY.
- 225S. TRANSIENT AND HIGH FREQUENCY PHENOMENA. Transient phenomena in coupled circuits. Distribution of current and flux in conductors at high and low frequencies. Change of resistance with frequency. Theoretical study of special problems. Prerequisites: Electrical Engineering 223. Two credits. MR. JANSKY.
- 232f-234W-236S. ELECTRICAL DESIGN. Special problems. Prerequisites: Electrical Engineering, 125, 136. Credits as arranged. MR. RYAN, MR. KUHLMANN.

- 237s. ELECTRIC POWER TRANSMISSION DESIGN. Preparation of detailed plans and specifications for the construction of high voltage transmission lines and distributing systems. Economic, electrical, and mechanical principles and calculations. MR. RYAN.
- 251W-253s. ILLUMINATING ENGINEERING. Lectures and laboratory work. Methods of determining location, kind, and quality of lights for obtaining desired illumination. Prerequisite: Electrical Engineering 151. Two credits per quarter. MR. SHEPARDSON.
- 281W-282s. ADVANCED ALTERNATING CURRENT MEASUREMENTS. Vector treatment of circuit networks. Bridge circuits for the measurement of resistance, inductance, and capacity at audio and radio frequencies. Prerequisite: Electrical Engineering 126. Two credits per quarter. MR. JANSKY.
- 284f-285W-286s. PRECISE ELECTRICAL ENGINEERING MEASUREMENTS. Lectures and laboratory work. Open to a limited number subject to approval. Prerequisites: Electrical Engineering 123, 124. One or two credits. MR. SPRINGER.
- 271f-272W-273s. GRADUATE THESIS. An investigation of an approved problem in electrical engineering. Three to nine credits per quarter.
- 275f-276W-277s. ELECTRICAL ENGINEERING RESEARCH. Investigation of special problems in laboratory or library. Prerequisite: Electrical Engineering 126. Two to four credits per quarter. MR. SHEPARDSON, MR. SPRINGER, MR. RYAN, MR. MARTIN, MR. JANSKY, MR. KUHLMANN.
- 294f-295W-296s. ELECTRICAL IGNITION AND AUTOMOBILE ELECTRICAL ACCESSORIES. The study of ignition apparatus; characteristics of automobile accessories, such as generators, starters, controllers, etc. Laboratory and lectures. Prerequisite: Electrical Engineering 121 or equivalent. Two credits per quarter. MR. SPRINGER.

ENGLISH

Professors ELMER E. STOLL, RICHARD BURTON,¹ FREDERICK KLAEBER (Comparative Philology), JOSEPH M. THOMAS;² Associate Professors JOSEPH W. BEACH, CECIL A. MOORE; Assistant Professors KEMP MALONE, CHARLES W. NICHOLS, MARTIN B. RUUD,² EMERSON G. SUTCLIFFE.

Before registering for graduate courses, students should consult with the director of graduate work for the department, Professor Cecil A. Moore.

Before the acceptance of the subject for a thesis candidates for the M.A. or the Ph.D. degree must have given evidence to the department that they speak and write English with propriety.

¹ Absent on leave, fall and winter quarters.

² Absent on leave, 1922-23.

REQUIREMENT FOR MASTER OF ARTS DEGREE

1. *Prerequisite*.—For major work, not less than 27 credit hours in the subject, including satisfactory introductory courses in Old English and either Chaucer or Shakespeare.

If English is offered as a minor, not less than 27 credit hours in the subject.

2. A candidate is not permitted to count toward the degree more than one course running through the year (or its equivalent) the primary purpose of which is practice in writing.

REQUIREMENTS FOR DOCTOR OF PHILOSOPHY DEGREE

1. *Delimitation of the field*.—The general field of English is divided into two periods (1) Early English and (2) Modern English. The boundary line between these periods may be drawn anywhere between 1500 and 1550 according to the requirements of the candidate's program. A candidate may select as his major subject either the Early English or the Modern English period.

2. The candidate will be examined as to his knowledge of the whole field of English literature, but much more thoroughly in that portion of the field covered by his major. Special emphasis will be laid, in the final examination, on one particular period or one particular type (such as drama, lyric, or essay) with which he is presumed to be especially familiar. This particular period or type would naturally be that connected with his thesis.

3. The candidate must have completed, before examination, advanced courses in Chaucer and Shakespeare.

4. A good reading knowledge of Latin is in all cases desirable, and in some cases may be indicated by the candidate's adviser as indispensable.

COURSES IN ENGLISH

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

101f. INTRODUCTION TO MIDDLE ENGLISH. An outline of Middle English grammar, including the interpretation of selected texts. Prerequisites: English 6 and 50. Two credits. V; TTh; 212F. MR. KLAEBER.

103s. BEOWULF. An introduction to the Old English poem, with reading of considerable portions of the text. Prerequisites: either Course 6 or 8 and 50. Three credits. V; MWF; 205F. MR. KLAEBER.

105-106.† EIGHTEENTH-CENTURY POETRY. From Pope to Burns, with special reference to the rise and growth of naturalism and romanticism. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Six credits. (Not given in 1922-23.) MR. MOORE.

107w-108s.† EIGHTEENTH-CENTURY PROSE. Special study of fiction and the essay. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Six credits. VII; MWF; 204F. MR. MOORE.

- 109-110.† THE ROMANTIC POETS OF THE NINETEENTH CENTURY. From Wordsworth to Keats and the influence of the French revolution. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Six credits. (Not given in 1922-23.) MR. BEACH.
- 111-112.† SEVENTEENTH-CENTURY PROSE. General survey of the prose of the century to 1660. History 3-4 is desirable as preparation for this course. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Six credits. (Not given in 1922-23.) MR. MOORE.
- 123f-124w-125s. STUDIES IN VICTORIAN NOVELISTS. George Meredith; or, in alternate years, Thomas Hardy and Henry James. Hardy and James in 1922-23. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Nine credits. 4 to 6 o'clock; T; 205F. MR. BEACH.
- 129s. MODERN DRAMA. Contemporary drama from 1870 to the present. Prerequisites: Course 8 and one other course numbered above 5. Four credits. II; MWThF; 301F. MR. BURTON.
- 136s. ADVANCED SHAKESPEARE. Shakespeare's development traced to the end. A careful analysis of four plays. Problems in the interpretation of Shakespeare's dramatic methods. Prerequisites: Course 8 and one other course numbered above 5. Open without further prerequisites to students receiving B in Course 8. Four credits. I; MTThF; 205F. MR. STOLL.
- 140s. ADVANCED CHAUCER. The more important of Chaucer's poems aside from *The Canterbury Tales*; the source and chronology of Chaucer's work. Prerequisites: Course 6 and one other course numbered above 5. Open without further prerequisites to students receiving B in Course 6. Four credits. IV; MWFS; 205F. MR. MALONE.
- 141-142-143.† HISTORICAL GRAMMAR OF THE ENGLISH LANGUAGE. This course is identical with Comparative Philology 141-142-143. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Six credits. (Not given in 1922-23.) MR. KLAEBER.
- 146f-147w.† THE METRICAL ROMANCES. The more important Middle English romances; an introduction to the great stories of love and chivalry current in the Middle Ages, particularly those connected with Arthur and the Round Table. Prerequisites: Course 6 and one other course numbered above 5. Six credits. VII; MWF; 205F. MR. MALONE.
- 150f. VICTORIAN POETRY. The poetry of the Victorian era, aside from Browning's and Tennyson's. The principal names are: Matthew Arnold, the Rossettis, Fitzgerald, Morris, Swinburne, and Meredith. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Four credits. VI; MTWF. MR. STOLL.

151. RECENT POETRY. Poetry in England and America since the death of Queen Victoria. The main tradition and tendencies now prevailing. Prerequisites: either Course 6 or 8 and one other course numbered above 5. Four credits. (Not given in 1922-23.) MR. BEACH.
- 155s. THE AMERICAN NOVEL. The beginnings of the American novel and short story and their development to about 1865. Among the writers included are Charles Brockden Brown, Irving, Cooper, Poe, Hawthorne, Thomas Bailey Aldrich. Prerequisites: either Course 6 or 8 and 44-45. Four credits. V; MTWF; 204F. MR. MOORE.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f. OLD ENGLISH. Comparative study of Anglo-Saxon (Old English) grammar and reading of prose texts. Once a week, two hours. Three credits. MR. KLAEBER.
- 202W-203s. OLD ENGLISH POETRY. Critical reading of poems. Once a week, two hours. Six credits. MR. KLAEBER.
208. PIERS THE PLOWMAN. A study of critical problems relating to the text and authorship. Three credits. (Not given in 1922-23.)
- 209f-210W-211s. THE MIDDLE ENGLISH LYRIC. (Not given in 1922-23.)
- 213f-214W-215s. SEMINARY IN EIGHTEENTH-CENTURY DRAMA. Special attention will be given to the rise and progress of sentimental comedy and domestic tragedy. Nine credits. 4 to 6 p.m.; Th; 302F. MR. MOORE.
218. SEMINARY IN THE RESTORATION DRAMA. The drama from the Restoration to the rise of sentimental comedy. Special attention given to the comedy of manners (from Etherege to Farquhar) and its relation to the life of the time. Nine credits. (Not given in 1922-23.) MR. STOLL.
- 225-226-227. SEMINARY IN ELIZABETHAN DRAMA. Elizabethan and Jacobean dramatists, from Lyly to Shirley. Problems assigned may involve Shakespeare, and in general his contemporaries will be studied less for their own sakes than for the light they shed upon him. Nine credits. (Not given in 1922-23.) MR. STOLL.
- 228-229-230. SEMINARY IN EIGHTEENTH-CENTURY NOVEL. The rise and development of the novel as a form of literature; the use made of the novel as a medium for religious, social, and political theory. Nine credits. (Not given in 1922-23.) MR. MOORE.
- 234f-235W-236s. SEMINARY IN MIDDLE ENGLISH LITERATURE. In 1922-23 the literary monuments will be studied with reference to the mythological and folklore material which they contain. Nine credits. 4 to 6 p.m.; W; 302F. MR. MALONE.

For courses in Comparative Literature see page 40.

COURSES IN RHETORIC

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

100W-101S.† VERSIFICATION. The nature of poetry and a detailed analysis of English meters and the various English verse forms. The theory accompanied by criticism of current poetry and practice in writing verse. Open to those who have taken Course 11-12-13 or 15-16-17, and who have taken or are taking nine hours in the historical study of English poetry. Six credits. IV; TS and ar.; 304F. MR. NICHOLS.

111f-112W-113S. ESSAY-WRITING. Practice in writing didactic, biographical, critical, informal essays. Extended composition. Individual aid in gathering of material, planning of papers, and criticism of essays. Analysis of a considerable body of modern essays. Prerequisites: Rhetoric 11-12-13, or 15-16-17. Nine credits. III; MWF; 304F. MR. SUTCLIFFE.

115f-116W-117S. DRAMATIC TECHNIQUE. Principles of plotting, characterization, climax, dialog, and scenario-making. Writing of three plays—two original, one dramatized short story. Required readings, laboratory work, criticisms of local productions. Open to those who have taken Course 11-12-13 and have taken or are taking English 129. Nine credits. III; TThS; 304F.

119f-120W-121S. SEMINAR IN WRITING. Open to advanced students who write with facility and who desire personal direction. Criticism of manuscripts submitted. Open with special permission to seniors and graduates who have completed Course 11-12-13, and nine additional credits in rhetoric. Nine credits. V, VI; Th; 304F. MR. BEACH.

COURSES PRIMARILY FOR GRADUATE STUDENTS

201f-202W-203S. SEMINAR IN RHETORIC. (Graduate seminar but open to seniors taking the Honors Course.) For those who are specializing in rhetoric and composition. Prerequisites: Course 11-12-13 or 15-16-17 and 9 additional credits in rhetoric. Nine credits. (Not given in 1922-23.) MR. THOMAS.

ENTOMOLOGY AND ECONOMIC ZOOLOGY

Professors WILLIAM A. RILEY, ARTHUR G. RUGGLES, FREDERIC L. WASHBURN; Assistant Professors ROYAL N. CHAPMAN, HARRY H. KNIGHT, OSCAR W. OESTLUND.

Prerequisites.—Eighteen credits in animal biology and entomology.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

117f-118W-119S. GENERAL ECOLOGY OF INSECTS. General ecology with special reference to the insects of Minnesota. Frequent field trips. Lectures, laboratory, and field work. V-VII; TTh; 208-210AB. MR. CHAPMAN.

- 125f-126w-127s. **ADVANCED GENERAL ENTOMOLOGY.** Morphology and classification of insects with lectures on the history of entomology. Lectures and laboratory. III, IV; TThS; 208-210AB. MR. OESTLUND.
- 130w. **BIOLOGY AND TAXONOMY OF THE APHIDIDAE.** Intensive study of the natural history, bibliography, and classification of the Aphididae. Additional work is offered under Course 175. IIII, IV; MWF; 208-210AB. MR. OESTLUND.
- 139-140. **HISTORY AND DEVELOPMENT OF INSECTS.** Lectures and laboratory work on the histology, embryonic and postembryonic development of insects. Individual work along these lines is available to properly qualified students under Course 197. II-VI; TTh, and ar.; 321-Adm. (F). MR. RILEY.
- 144f-145w-146s. **ANIMAL PARASITES AND PARASITISM.** Lectures and laboratory work. Second term devoted primarily to the relation of insects to diseases of man and animals. V-VII; WF; 208-210AB. MR. RILEY.
- 150su. **INSECTICIDES AND THEIR ACTION.** Ar; Insectary (F).
- 197f,w,s,su. **INTRODUCTION TO RESEARCH.** Preparation for investigational work in lines of entomology, parasitology, or economic zoology. Summer work should be planned when possible. MR. RILEY, parasitology, insect morphology; MR. RUGGLES, general economic entomology; MR. WASHBURN; economic vertebrate zoology, insecticides; MR. KNIGHT, MR. OESTLUND, systematic entomology.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-204. **RESEARCH IN ENTOMOLOGY.** MR. RILEY, MR. OESTLUND, MR. CHAPMAN, MR. KNIGHT.
- 205-208. **RESEARCH IN ECONOMIC ENTOMOLOGY.** MR. RUGGLES, MR. GRAHAM.
- 209-212. **RESEARCH IN ECONOMIC VERTEBRATE ZOOLOGY.** MR. WASHBURN.
- 261-264. **RESEARCH IN PARASITOLOGY AND MEDICAL ENTOMOLOGY.** MR. RILEY.
- 265-268. **RESEARCH IN INSECTICIDES.**

EXPERIMENTAL ENGINEERING LABORATORIES

Professors WILLIAM E. BROOKE, JOHN J. FLATHER, WILLIAM F. HOLMAN, FRANK B. ROWLEY; Assistant Professors GEORGE A. MANEY, GEORGE C. PRIESTER, BURTON J. ROBERTSON, CHARLES F. SHOOF; Professorial Lecturer JOHN H. ROWEN.

NOTE: Experimental work relating to various branches of engineering may be carried on in the Experimental Engineering laboratories. The following courses are offered by the departments indicated. Work of a special character, such as advanced research, may be arranged through consultation with the director, Professor Rowley.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- M. M. 141f,w,s. MATERIALS-TESTING LABORATORY. Investigation of the physical properties of various metals and engineering materials. One credit. MR. BROOKE, MR. HOLMAN, MR. PRIESTER.
- M. M. 143f,w,s. HYDRAULIC LABORATORY. Experimental and demonstrational work. One credit. MR. BROOKE, MR. HOLMAN, MR. PRIESTER.
- M. E. 181w. ADVANCED GENERAL LABORATORY. Indicator practice, valve-setting, separating and throttling calorimeters, tests of steam engines, gas engines, pumps, air compressors, blowers, turbines, boilers, and power plant. Four actual hours. MR. ROWLEY, MR. SHOOP.
- M. E. 182f. ADVANCED STEAM LABORATORY. Tests of steam turbines, flow of steam through nozzles and pipes. Tests of compounds and triple expansion engines, condensers, superheaters, and boilers. Two credits. MR. SHOOP.
- M. E. 183w. POWER AND GAS ENGINE LABORATORY. Tests of gas, gasoline, and hot air engines, gas producers. Power and lighting plants. Two credits. MR. ROWLEY, MR. ROBERTSON.
- M. E. 184s. ADVANCED ENGINEERING LABORATORY. Opportunity will be offered for carrying on investigations in connection with tests of complete power plants, refrigerators, air compressors, blowers, and fans. Also automobile testing and gas engine investigations. Two credits. MR. ROWLEY, MR. ROBERTSON, MR. SHOOP.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- C. E. 237w-238s. STRUCTURAL LABORATORY. Similar to Course 243, but dealing mainly with experimental problems in structural steel. MR. MANEY, MR. LAGAARD.
- C. E. 243w-244s. CEMENT AND CONCRETE LABORATORY. Laboratory technique and experimental investigation of special problems in cement, concrete, and reinforced concrete. MR. LAGAARD.
- C. E. 251. HIGHWAY LABORATORY. Investigations in coöperation with State Highway Department. MR. LANG.
- C. E. 263. HYDRAULIC LABORATORY. Study of special hydraulic problems in laboratory, drafting room, and field.
- M. E. 287-288-289. RESEARCH IN MECHANICAL ENGINEERING. Courses may be elected which involve investigations in connection with steam and gas engines, heating, and ventilating. Reports, special problems, and related tests. Three to 9 credits. MR. FLATHER, MR. ROWLEY, MR. SHOOP, MR. ROWEN.

FORESTRY

Professors EDWARD G. CHEYNEY, JOHN H. ALLISON; Associate Professor JOHN P. WENTLING.

Prerequisites.—For major work, 27 credits in forestry, three quarters of botany or equivalent. For minor work, 9 credits in the department.

Exemptions from the language requirement for the Master's degree may be made in individual cases.

The choice in subject must be made by the candidate and approved by the chief of the division and instructor. The facilities of the forest experiment stations at Cloquet and Itasca are available to students taking this work.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101W. ADVANCED DENDROLOGY. A combination of Courses 2 and 5 with special studies in classification and distribution. Prerequisites: 10 credits in botany and 8 credits in dendrology. Three credits. W; ar. MR. WENTLING.
- 106W. RESEARCH METHODS IN SYLVICULTURE. The fundamental principles upon which silviculture is based, methods used at experiment stations in solving problems in forestation, protection, and management. Prerequisites: 9 credits in silviculture. Three credits. I; MWF.
- 107f, 108W, 109s.† USES OF WOOD. An inclusive study of the economic hard and soft woods, both domestic and foreign. At least six hours per week must be spent in actual study in a factory in the spring quarter. Lectures, reading, reports. Prerequisite: Course 17-18. Nine credits. II; MWF in the fall, and IV; MWF in winter and spring; 303Hr. MR. WENTLING.
- 110W. MECHANICAL AND PHYSICAL PROPERTIES OF WOOD. Study of strength as related to density, quality, etc. Wood stresses, failures, and methods of testing timbers. V, VI; WF. MR. WENTLING.
112. ADVANCED FOREST MENSURATION. Continuation of Course 10 with special emphasis on tree forms, the development of the formula used in study of volume and growth of trees. MR. HANSEN.
- 113W. ADVANCED FOREST BY-PRODUCTS. A detailed study of production of wood pulp and paper products, naval stores, tannins, oils, wood distillation products, etc. Lectures, reading, reports. Prerequisites: 33-34, Chem. 3 or 10 and Chem. 36. Ar; 302Hr.
- 119f. ADVANCED WOOD STRUCTURE I. A detailed study of the elements and structure of native and foreign economic woods. Preparation, sectioning, and mounting of typical sections. Reference reading and reports. Six hours per week. Prerequisites: Courses 33-34. Three credits. MR. WENTLING.

- 120W. ADVANCED WOOD STRUCTURE II. Study of wood structure in relation to seasoning, mechanical failures, penetration or preservatives, variation in strength, etc. Six hours per week. Prerequisite: Course 119. Three credits. MR. WENTLING.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-202. RESEARCH PROBLEMS IN SCIENCE AND PRACTICE OF SYLVICULTURE. MR. WENTLING.
- 203-204. RESEARCH PROBLEMS IN MANAGEMENT AND WORKING PLANS. MR. ALLISON.
- 205-206. LUMBER MARKETS AND PRICES. MR. CHEYNEY.
- 207f-208W-209S. RESEARCH IN WOOD TECHNOLOGY. MR. WENTLING.

GEOLOGY AND MINERALOGY

Professors WILLIAM H. EMMONS, FRANK F. GROUT, CLINTON R. STAUFFER;
Assistant Professor THOMAS M. BRODERICK.

Prerequisites.—For major work in:

General geology and economic geology, Courses 1, 2, 21, 22; a knowledge of general chemistry. Course 105 must be carried along with other graduate work.

Petrology, Courses 1, 2, 21, 22, elementary chemistry and physics.

Paleontology, 1, 2, 57, 58, 59, or 1, 2, 91-92-93. Animal biology is a desirable antecedent.

Geography, 1, 2, 29, 114, 37. For minor work, Geology 29, 114, 37.

Exemptions from the language requirements for the Master's degree may be made in individual cases. Students who are deficient in modern languages are advised to take a language along with their other graduate work. Examinations in French and German are required of candidates for service on the United States Geological Survey.

COURSES

- 101f. PRINCIPLES OF STRATIGRAPHY. Origin and structure of sedimentary deposits; the interpretation of these in relation to paleogeography; field work in connection with Cambrian and Ordovician problems. Three credits. MR. ALLISON.
- 105f. ELEMENTS OF ROCK STUDY. Prerequisite: Course 22 or 25. Three credits. VI, VII; TTh; 110P. MR. GROUT.
- 106W. PETROGRAPHY. The identification and study of minerals and rocks by topical methods; the study of igneous rocks, crystalline schists, and metamorphic rocks. The origin and classification of rocks. Prerequisite: Course 105. Three credits. VI, VII; TTh; 110P. MR. GROUT.
- 107f-108W-109S. PALEONTOLOGIC PRACTICE. The collection, preparation, and study of materials, with a view to gaining a working knowledge of

- groups of fossils, and the use of literature. Prerequisite: Course 59. Nine credits. V, VII; MWF; 105P. MR. STAUFFER.
- 111f. ORE DEPOSITS. The nature, distribution, and genesis of ore deposits of the United States; relations of ore deposits to geologic structure; the deformation and superficial alteration of ore deposits. Prerequisites: Courses 2, 105. Three credits. I; TThS; 110P. MR. EMMONS.
- 112W. GEOLOGY OF PETROLEUM. First part treats deposits of metals, giving special attention to those outside of the United States. Second half treats the nature, origin, and distribution of petroleum and discusses the various oil fields of the world. Prerequisite: Course 111. Three credits. I; TThS; 110P. MR. EMMONS.
- 113S. PROBLEMS IN ORE DEPOSITS. Field excursions, map work, lectures on field and laboratory methods. Prerequisite: Course 112. Three credits. V, VIII; T; 110P. MR. EMMONS.
- 124W-125S. STRUCTURAL AND METAMORPHIC GEOLOGY. The conditions, processes, and results of metamorphism; structural features resulting from deformation under varying conditions of load. Prerequisites: Courses 2, 105. Six credits. VI; MWF; 200aP. MR. SCHWARTZ.
- 131f-132W-133S. ADVANCED PETROLOGY. Advanced optical methods. Regional and genetic studies. Petrographic reports. Prerequisite: Course 106. Nine credits. Hours to be arranged. 200P. MR. GROUT.
- 137W. TESTING ECONOMIC MINERALS. Laboratory tests of coal, clay, oil, building stone, and metallic ores. Prerequisites: Courses 2, 105. Three credits. T; 200P. MR. GROUT.
- 140W-141S. APPLIED PETROGRAPHY. Determination of ore and gangue minerals, microscopic studies of paragenesis of ores and other mineral associations. Practical problems in mining and geology, settled by microscopic and optical examination. Prerequisite: Course 131. Six credits. Hours to be arranged. 200P. MR. GROUT.
- 144W-145S. CONSTRUCTION AND INTERPRETATION OF GEOLOGIC MAPS. Methods of geological examination; study and problems in construction and interpretation of geologic maps. Prerequisite: Course 2. Six credits. Hours to be arranged. 104P. MR. ALLISON.
- 150S. FIELD GEOLOGY. Detailed, systematic work, conforming to official surveys. Field for 1921, Black Hills, South Dakota. Reports to be written week before college opens. For prerequisites see members of the department. Ten credits. MR. EMMONS, MR. SCHWARTZ.
- 151f-152W-153S. ADVANCED GENERAL GEOLOGY. Geologic processes and their results; development of the North American continent. Prerequisite: Course 2. Nine credits. III; MWF; 104P. MR. STAUFFER.

- 166W-167S. MINERALOGRAPHY. Methods of studying opaque minerals and application of the methods to problems in ore genesis and history. Prerequisite: Course 111. Six credits. Hours to be arranged. 103P. MR. BRODERICK, MR. SCHWARTZ.

COURSES PRIMARILY FOR GRADUATE STUDENTS

211. ADVANCED PALEONTOLOGY. Selected groups of fossils. Class work supplemented by reference reading and thesis. Three credits. MR. STAUFFER.
214. SEMINAR IN ORE DEPOSITS. Three credits. MR. EMMONS.
- 215S. GEOLOGY AND ORE DEPOSITS OF THE WESTERN HEMISPHERE. Open to graduate students and to those undergraduates who have had Course 111. Offered in spring quarter, 1924. Three credits. MR. EMMONS.
- 216S. GEOLOGY AND ORE DEPOSITS OF THE EASTERN HEMISPHERE. Prerequisites same as for Course 215. Offered in spring quarter 1923. Three credits. MR. EMMONS.
220. GLACIAL GEOLOGY. Hours to be arranged. The drift sheets, glacial lakes, the gorge of St. Anthony Falls, the Dalles of the St. Croix, and other problems. Lectures, reference reading, and field work.
241. FIELD COURSE IN GEOLOGY. To be arranged with individual students upon application to the department. Credit will be given for field work done satisfactorily as prescribed in the joint announcement of various universities.
- 243-244. RESEARCH COURSE IN GEOLOGY. Advanced work in general geology; chiefly individual work on selected subjects. Data and collections of material gathered in the course of field work studied under instructor. Methods follow standards of federal and state surveys. MR. EMMONS, MR. GROUT, MR. STAUFFER.
246. PRE-CAMBRIAN GEOLOGY. The problems of pre-Cambrian correlation and structure; the pre-Cambrian stratigraphy of North America. Given in alternate years. Three credits.
247. GEOLOGY AND EXPLORATION OF LAKE SUPERIOR REGION. The geology of the Lake Superior iron district. The methods used in the exploration of iron ore; interpretation of drill cores; cartographic expression of drill data; models of drilled areas. The principles of magnetic surveying. Three credits.
- 251-252. ORIGINAL PROBLEMS. Morphology and physical measurements of minerals. Three credits each. MR. GROUT.
- 253-254. RESEARCH COURSE IN ORE DEPOSITS. Methods of Course 243-244 applied to ore deposits. Three credits each. MR. EMMONS. MR. GROUT.

263-264. RESEARCH COURSE IN PETROLOGY. Methods of Course 243-244 applied to petrology. Three credits each. MR. EMMONS, MR. GROUT.

GERMAN

Professor CARL SCHLENKER; Assistant Professors OSCAR C. BURKHARD, JAMES DAVIES, SAMUEL KROESCH.

Prerequisites.—For major work, 27 Senior College quarter credits or equivalent. For minor work, 18 Senior College credits or equivalent. For courses in Germanic Philology see the statement of the Department of Comparative Philology.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

100f-101w-102s. MIDDLE HIGH GERMAN. Phonology, morphology, and syntax. Nine credits. VI; MWF; 212F. MR. KROESCH.

104f-105w-106s. HISTORY OF THE GERMAN LANGUAGE. Lectures, discussions, assigned readings. This course is identical with Comparative Philology 109-110-111. Nine credits. MR. KLAEBER.

107f. HISTORICAL GERMAN GRAMMAR. Phonology, inflection, word formation, syntax. Intended primarily for prospective teachers of German. Three credits. (Not offered in 1922-23.) MR. KROESCH.

108w. COMPARATIVE PHONETICS. A study of speech sounds and the nature of their production, with special reference to English, French, and German. Open to students in the modern languages. Three credits. MR. KROESCH.

150f-151w-152s. DIE NOVELLE. A study of the technique and development. Assigned readings and reports. Nine credits. VI, VII, VIII; Th; 208F. MR. BURKHARD.

153f-154w-155s. ASPECTS OF GERMAN LITERATURE OF THE NINETEENTH CENTURY. The subject of the course will be announced from year to year. Nine credits. (Not offered in 1922-23.) MR. BURKHARD.

160f-161w-162s. LYRIC POETRY OF THE EIGHTEENTH AND NINETEENTH CENTURIES. Nine credits. VI, VII, VIII; M; 209F. MR. DAVIES.

COURSES PRIMARILY FOR GRADUATE STUDENTS

225f-226w-227s. LITERARY PROBLEMS. Subject for 1921-22: Drama of the second half of the nineteenth century. Nine credits. VI, VII, VIII; W; 209F. MR. SCHLENKER.

GREEK

Professor CHARLES ALBERT SAVAGE.

Prerequisites.—For major work, Courses 105, 106, 107, or their equivalent. For minor work, Courses 51 (Philosophy), 52 (Oratory), 53 (Dramatic Poetry), or their equivalent.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 105f. LYRIC POETRY. Selections from the elegiac, iambic, lyric, and bucolic poets. Three times a week. Prerequisites: Greek 51 and 53, or 52 and 53. Three credits. Ar. 112F. MR. SAVAGE.
- 106w. ADVANCED DRAMA. Aeschylus, Sophocles, or Aristophanes. Special attention given to the development of the drama, and to the literary form of dramatic representation of the plays read. Three times a week. Prerequisite: Greek 53 or 105 or equivalent. Three credits. Ar. 112F. MR. SAVAGE.
- 107w. ADVANCED PROSE. Selections from the Greek historians, or from Plato, or from the orators. Alternates with Course 106. Equivalent prerequisites. Ar. 112F. MR. SAVAGE.
- 108s. ADVANCED EPIC POETRY. A course of rapid reading in the *Iliad* or the *Odyssey*. Three times a week. Prerequisite: Greek 105 or 106. Three credits. Ar. 112F. MR. SAVAGE.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-202-203. ORATORY (advanced). A study of the development of oratorical style among the Greeks. Twice weekly, one, two, or three quarters. MR. SAVAGE.
- 204-205-206. DRAMATIC POETRY (advanced). The reading and critical study of representative Greek plays. Twice weekly, one, two, or three quarters. Alternates with 201-202-203. MR. SAVAGE.
- 207-208-209. SEMINAR IN PHILOSOPHY OR ORATORY. Once a week, one, two, or three quarters. MR. SAVAGE.
- 210-211-212. GREEK HISTORY (advanced). Selected readings from Greek historians. Once a week, one, two, or three quarters. Alternates with 207-208-209. MR. SAVAGE.

HISTORY

Professors GUY STANTON FORD, CLARENCE WALWORTH ALVORD, SOLON J. BUCK, WILLIAM STEARNS DAVIS, NORMAN SCOTT BRIEN GRAS, ALBERT BEEBE WHITE, QUINCY WRIGHT (Political Science); Associate Professors AUGUST CHARLES KREY, LESTER BURRELL SHIPPEE, MASON WHITING TYLER; Assistant Professor GEORGE M. STEPHENSON.

Prerequisites.—Of the four fields in which general survey courses in history are usually given, namely, ancient, American, English, and European, students entering upon graduate work in history will usually be expected to have covered two or three courses, with credit not exceeding 18 hours. For the other 9 hours, they should have a more advanced course in one of these fields and a second course in some field of history in which intensive work is done with the beginnings of investigation. In meeting these requirements consideration will be given to work done from the historical

point of view in others of the social sciences, especially political science. The department attaches considerable importance to adequate preparation in the foreign languages, which may be used by the student in the course of advanced and research work. An especially good equipment here will be taken into consideration in weighing the student's preparation for graduate work.

AMERICAN HISTORY

- 112s. HISTORY OF AMERICAN IMMIGRATION. Settlement and development of typical racial stocks in America. Contributions of European immigrants to American life. Attention to political history. Prerequisites: 20 credits in social science group. Four credits. VI; MWThF; 111Lib. MR. STEPHENSON.
- 125w. (Pol. Sci.) AMERICAN DIPLOMATIC HISTORY. Prerequisites: 20 credits in social science group, including 10 credits in political science or History 5-6. Four credits. III; MWFS; 102MA. MR. WRIGHT.
- 127s. (Pol. Sci.) AMERICAN FOREIGN RELATIONS. Such topics as the Monroe Doctrine, freedom of the seas, the open door, arbitration, disarmament, will be considered with particular reference to the future policy of the United States. Prerequisites: 20 credits in social science group, including 10 credits in political science or History 5-6. Four credits. III; MWFS; 102MA. MR. WRIGHT.
141. THE WEST IN AMERICAN HISTORY TO 1815. Prerequisites: 20 credits in social science group, including History 5-6. Three credits. (Not offered in 1922-23.) MR. BUCK.
142. THE WEST IN AMERICAN HISTORY, 1815-65. This course, while offered separately, follows, and is calculated to form a natural sequence to History 141. Prerequisites: 20 credits in social science including History 5-6. Three credits. (Not offered in 1922-23.) MR. SHIPPEE.
- 144f-145w.† HISTORY OF MINNESOTA. The settlement and development—political, economic, and social—of a typical American commonwealth. Prerequisites: 15 credits in social science including History 5-6. Six credits. VIII; MWF; 112Lib. MR. BUCK.
- 146w-147s.† CONSTITUTIONAL HISTORY OF THE UNITED STATES. The evolution of American constitutional government through legislation, judicial interpretation, administrative rule, and custom. Prerequisites: 15 credits in history or 10 credits in history and 10 in social science including 5 credits in political science. Six credits. IV, MWF; 112Lib. MR. SHIPPEE.
- 148f-149w-150s.† BRITISH EMPIRE IN THE EIGHTEENTH CENTURY. A study of imperial politics, including the development of the English colonies in America and the American Revolution. Prerequisites: 20 credits in the social sciences, including 10 credits in history. Nine credits. II; MWF; 218aLib. MR. ALVORD.

153. THE WEST IN AMERICAN POLITICS SINCE 1865. An intensive study of independent parties and radical or progressive political movements. Prerequisites: 25 credits in history including History 5-6. Five credits. (Not offered in 1922-23.) MR. BUCK.
- 154s. SELECTED TOPICS IN THE HISTORY OF MINNESOTA. Students taking this course are expected to do a portion of their work in the library of the Minnesota Historical Society. Prerequisites: 25 credits in history including History 5-6. Five credits. VII, VIII; WF; 218aLib. MR. BUCK.
155. UNITED STATES, 1850-65. Consideration is given to social and economic questions as well as political issues. Prerequisites: 25 credits in history including History 5-6. Five credits. (Not offered in 1922-23.) MR. SHIPPEE.
- 156f. THE RECONSTRUCTION PERIOD. This course follows History 155 as a natural sequence. Prerequisites: 25 credits in history, including History 5-6. Five credits. VII, VIII; WF; 218aLib. MR. SHIPPEE.
- 160w. SELECTED TOPICS IN LATER AMERICAN COLONIAL HISTORY. Prerequisites: 25 credits in social science, including History 5-6 or 148-149-150. Five credits. VII, VIII; MW; 218aLib. MR. ALVORD.
- 166f. SELECTED TOPICS IN THE HISTORY OF IMMIGRATION. Competent students will be guided in research. Prerequisites: 25 credits in social science and consent of instructor. Five credits. VII, VIII; TTh; Ar. MR. STEPHENSON.
- 208f-209w-210s. SEMINAR IN AMERICAN HISTORY. Graduate students only. Ar. MR. ALVORD, MR. BUCK, MR. SHIPPEE, MR. STEPHENSON.
- See also History 113-114-115† under Economic History; History 121-122† under English History, and History 111 under European History.

ANCIENT HISTORY

- 103f. THE NEAR EAST, OLD ORIENT. Origin of Egyptians, Babylonians, Assyrians, and Persians, and main features of their political history and civilization. History of the Hebrews discussed so far as it bears upon general oriental problems. Prerequisites: 20 credits in social science group. Five credits. VIII; MWF; 111Lib. MR. DAVIS.
- 105w. HISTORY OF ROME.* Prerequisites: 20 credits in social science group. Five credits. III; MTThFS; 111Lib. MR. DAVIS.
- 133f. POLITICAL HISTORY OF GREECE. With special reference to the reaction upon cultural progress. Prerequisites: 20 credits in history or a major in Greek or Latin. Five credits. III; MTThFS; 111Lib. MR. DAVIS.

* Students who took History 135 in the year 1920-21 may not elect History 105 without consent of instructor.

- 134w. ANCIENT CIVILIZATION, GREECE. Social and intellectual life of Greece. Prerequisites: 20 credits in history, or a major in Greek or Latin. Three credits. VIII; MWF; 111Lib. MR. DAVIS.
- 135s. ANCIENT CIVILIZATION, ROME. Social and intellectual life of Rome. The course will begin with a survey of political history. Prerequisites: 20 credits in history, or a major in Greek or Latin. Three credits. VIII; MWF; 111Lib. MR. DAVIS.

ECONOMIC HISTORY

- 113f-114w-115s.† ECONOMIC HISTORY OF EUROPE AND THE UNITED STATES, 1750 TO THE PRESENT. The industrial revolution and significant results for transportation, agriculture, tariff, and labor. Prerequisites: 20 credits in history or economics, or both. Nine credits. II; TThS; 111Lib. MR. GRAS.
- 116-117-118.† ECONOMIC HISTORY OF EUROPE, 1300-1750. Prerequisites: 20 credits in history or economics, or history and economics combined. Nine credits. (Not offered in 1922-23.) MR. GRAS.
- 169s. ECONOMIC HISTORY OF THE UNITED STATES SINCE THE CIVIL WAR. The chief emphasis is on the growth of manufacture and commerce, and government regulation. Prerequisites: 25 credits in history or economics, or history and economics combined. Five credits. III; TThS; 111Lib. MR. GRAS.
- 205-206-207. SEMINAR IN ECONOMIC HISTORY. Ar. MR. GRAS.

ENGLISH HISTORY

- 109f 110w. ENGLISH HISTORY, 1815-1920. Emphasis placed upon party history, the colonies, foreign relations, the social democratic movement, and especially British foreign policy preceding the World War. Prerequisites: 20 credits in social science group. Six credits. (Not offered in 1922-23.) MR. TYLER.
- 121w-122s.† ENGLISH BACKGROUNDS AND THE AMERICAN COLONIES. Studies in the transfer of English civilization, and its early modifications and development in America. Some account taken of the contrasting French settlements. Prerequisites: 20 credits in history or political science. Six credits. II; TThS; 112Lib. MR. WHITE.
- 162f. THE BEGINNINGS OF PARLIAMENT. From the Norman Conquest to the reign of Edward I, based wholly on original sources. Prerequisites: 25 credits in history including History 3-4; knowledge of at least high school Latin. Five credits. VIII-IX; TTh; 218aLib. MR. WHITE. See also courses in Economic History.

EUROPEAN HISTORY

- 101f-102w.†THE FRENCH REVOLUTION AND NAPOLEONIC ERA. Prerequisites: 20 credits in social science including 10 credits in history. Reading knowledge of French desirable. Six credits. (Not offered in 1922-23.) MR. FORD.
- 104s. THE NEAR EAST, MODERN. The Saracen Empire, Turkey, the Balkan States, and European diplomacy in the East since the beginning of the Middle Ages. Prerequisites: 20 credits in social science group including 10 credits in history. Five credits. III; MTThFS; III Lib. MR. DAVIS.
- 107f-108w. EUROPE, 1848-1914. Prerequisites: 20 credits in social science; if History 1-2 is not offered as a prerequisite, consent of instructor must be obtained. A reading knowledge of French and German will be helpful. Eight credits. VII; MTThF; III Lib. MR. TYLER.
- 111w. EUROPEAN BACKGROUND OF AMERICAN IMMIGRATION. The movement of population from Europe to America in the nineteenth century, with the emphasis on the economic, political, social, and religious forces. Prerequisites: 20 credits in social science group. Four credits. VI; TWThF; III Lib. MR. STEPHENSON.
- 119s. THE RENAISSANCE AND REFORMATION. Especial emphasis upon the work of individual men and upon ideas rather than upon politics and institutions. Prerequisites: 20 credits in history. Five credits. IV; MTWFS; III Lib. MR. KREY.
- 120f. MEDIEVAL CIVILIZATION. A study of the social and intellectual development of Europe from the period of the German migration to the end of the thirteenth century. Prerequisites: 20 credits in history. Five credits. IV; MTWFS; 112 Lib. MR. KREY.
- 131f-132w.†THE FORMATION AND FALL OF THE MODERN GERMAN EMPIRE. The principal emphasis is on the period since 1848. The work of Bismarck and the Empire under William II. Prerequisites: Twenty credits in social science, including 10 credits in history. Six credits. I; MWF; III Lib. MR. FORD.
- 158s. SELECTED TOPICS IN NINETEENTH-CENTURY HISTORY. Discussion based on a wide range of reading. Prerequisites: 25 credits in social science including History 107-108 or 101-102. A reading knowledge of French or German will be required. Ten credits. VII, VIII; TTh; 218a Lib. MR. TYLER.
- 164w. STUDIES IN THE CRUSADES. Prerequisites: 25 credits in history; knowledge of at least high school Latin. Five credits. MR. KREY.

201f-202w-203s. HISTORICAL BIBLIOGRAPHY AND CRITICISM. Required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere. I; S; 112Lib. MR. FORD, MR. WHITE, and others.

HOME ECONOMICS¹

Prerequisites.—For major work, 27 credits including Courses 13, 22, and 45 in Home Economics or their equivalent, 10 credits in general chemistry, 5 credits in organic chemistry, 5 credits in quantitative analysis, and 15 credits in biological science. For minor work 9 credits in the department and any additional prerequisite work needed to pursue the courses selected.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

103f,w,s. DIETETICS. The fundamental principles of human nutrition as applied to the feeding of individuals and groups under conditions of health, and under such pathological conditions as are chiefly dependent upon dietetic treatment. Three to 5 credits.

105w. EXPERIMENTAL COOKERY. An experimental study of special problems in food and food preparation. Three to 5 credits. MISS CHILD.

108f,w,su. NUTRITION II. A study of metabolism including work on tissues, blood, and urine. MISS ANDERSON.

109s. ADVANCED NUTRITION. A study of selected quantitative methods applicable to investigations relating to digestion and metabolism. MISS ANDERSON.

122f,w. ADVANCED TEXTILES. An experimental study of textile problems such as shrinkage and other laundering results; textile legislation and special economic problems. Three credits. MISS WELLER.

123f,w,s. CLOTHING ECONOMICS. General consideration of the economic problems in clothing production; women's responsibility for conditions in textiles and clothing industries; study of the budget for clothing and household textiles; hygiene and standardization of dress. Two credits. MISS WELLER.

131f,w,s. HOUSE-PLANNING AND EQUIPMENT. Construction and furnishing budgets. Types of domestic architecture; details of construction and furnishing. Five credits. MISS MORSE.

COURSES PRIMARILY FOR GRADUATE STUDENTS

110s. SPECIAL PROBLEMS IN DIETETICS. An intensive study involving assigned readings, discussions, and field work. Three credits.

¹The staff of this department will be announced later. Students majoring in Home Economics should ascertain by inquiry the fields in which students will be accepted in 1922-23.

- 111s. SPECIAL PROBLEMS IN FOODS AND COOKERY. A continuation of experimental cookery with more advanced problems. Three credits. MISS CHILD.
- 126s. PROBLEMS AND APPLICATION OF QUANTITATIVE METHODS IN TEXTILE ANALYSIS with special reference to establishing standards for fabrics.
- 151w. INSTITUTION MANAGEMENT PROBLEMS. Organization; service; institution-planning, decoration, and equipment; budgets, and the study of different types of institutions. Four credits. MISS TREAT.
- 203w-204s. HOME ECONOMICS PROBLEMS. Opportunity is offered for the investigation of selected problems in home economics. Five credits.
- 205-206-207. HOME ECONOMICS SEMINAR. A critical study of selected topics and recent advances in home economics involving outside reading, oral and written reports. Two credits each.

HORTICULTURE

Professors WILLIAM H. ALDERMAN, HERBERT K. HAYES; Associate Professors WILFRID G. BRIERLEY, LEROY CADY; Assistant Professor WILLIAM T. TAPLEY.

Prerequisites.—For major work, 15 credits; for minor work, 9 quarter credits in the department in addition to two years in botany and one year in entomology.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 107f. ORCHARD MANAGEMENT. A detailed study of the various operations in orchards and berry fields. Operating costs and profits. Lectures, laboratory, and individual problems. Prerequisite: Horticulture 6, botany, 9 credits. Three credits. IV; FS. V, VI; W; 102Hr. MR. BRIERLEY.
- 109f. PRINCIPLES OF GENETICS. Same as Agronomy and Farm Management 131. Lectures and laboratory work designed to familiarize the student with the underlying principles of breeding. Prerequisites: botany, 9 credits, animal biology, 10 credits. Three credits. MR. BEAUMONT, MR. GRIFFEE.
- 110w. HORTICULTURAL CROP-BREEDING. Applied genetics is emphasized. Methods of breeding each of the important horticultural crops with special attention to experiment station investigations and to the methods used by plant breeders. Prerequisite: Horticulture 109 or Agronomy 131. Three credits. I; TThS; 212Hr. MR. BEAUMONT, MR. BUSHNELL.
- 111f. SYSTEMATIC POMOLOGY. A study of fruit varieties. Lectures, laboratory, and a survey of the literature. Prerequisites: Horticulture 6, botany, 9 credits. II; TTh; V, VI; Th; 8Hr. MR. BRIERLEY.

- 131f. **ADVANCED VEGETABLE PRODUCTION.** A study of the business of vegetable-gardening. Special problems for investigation and research, reviews and reports on recent literature. Prerequisite: Horticulture 32, botany, 9 credits. Three credits. III; TTh. III, IV; S; 210Hr. MR. TAPLEY.
- 132f. **SYSTEMATIC OLERICULTURE.** The origin, botany, varieties, and types of the different vegetables, their characteristics and adaptation to different cultural and market conditions, identification and classification studies, judging, and exhibiting. Prerequisite: Horticulture 32, botany, 9 credits. III; MW; V, VI; Th; 102Hr. MR. KRANTZ.
- 133w. **COMMERCIAL TRUCK-GROWING.** Truck-growing centers of the United States, cultural methods used in producing various truck crops, special machinery and equipment, market methods, shipping points. Adaptation of truck crops to Minnesota, commercial production for canneries; handling; shipping to market. Prerequisite: Horticulture 32, botany, 9 credits. Three credits. III; TThS. MR. TAPLEY.
- 135w. **POTATO PRODUCTION.** A study of the origin, botany, regional distribution, economic importance, group classification, standardization of varieties according to soil, climate, and markets. Identification, exhibiting, judging, cultural methods, seed selection and certification, marketing and utilization. Prerequisite: Horticulture 6 or 32, botany, 9 credits. III; MW; V, VI; Th; 102Hr. MR. KRANTZ.
- 151f. **ADVANCED FLORICULTURE.** Lectures, assigned readings, laboratory, and special problems dealing with the culture, botany, and history of florists' plants and methods of greenhouse management. Prerequisites: Horticulture 50, botany, 9 credits. Three credits. Ar. MR. CADY.
- 191w-192s. **SPECIAL PROBLEMS.** A study of problems based upon the work given in the preceding courses. Two or 4 credits per quarter. MR. ALDERMAN.
- 193f-194w-195s. **HORTICULTURAL SEMINAR.** Reports and discussions of problems and investigational work. Required of graduate students. One credit per quarter. Horticultural staff.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f-202w-203s-204su. **FRUIT-GROWING RESEARCH.** Special problems in fruit culture or disposal. Students will be required to continue the work over at least one summer to arrange for concentration on problems at the most appropriate season. Open to those who have specialized in fruit-growing. Three to 6 credits per quarter. MR. ALDERMAN, MR. BRIERLEY.
- 209f-210w-211s-212su. **FRUIT-BREEDING RESEARCH.** Consists of (a) some thesis problem, (b) development of laboratory technique in breeding.

Work involves reading in genetics, cytology, biometry. Students required to continue work over one summer. Open to limited number specializing in fruit-breeding. Three to 6 credits per quarter. MR. ALDERMAN, MR. HAYES.

213f-214w-215s, or Agronomy and Farm Management 203f,w,s. PLANT-BREEDING SEMINAR. History of plant-breeding, application of recent genetic theories to crop improvement and a discussion of research problems. Weekly meetings throughout the year. Prerequisite: Horticulture 109. Maximum of 3 credits. MR. HAYES.

231f-232w-233s-234su. VEGETABLE-GROWING RESEARCH. Special problems in vegetable culture. Students will be required to continue the work over at least one summer. Open to those who have specialized in vegetable-growing. Three or 6 credits per quarter. MR. TAPLEY.

242w. METHODS AND INTERPRETATION OF HORTICULTURAL RESEARCH. A critical analysis of the more important horticultural investigations, together with a study of methods and organization of research work in horticulture. Two credits. MR. ALDERMAN.

LATIN

Professor JOSEPH B. PIKE; Assistant Professor ROBERT V. CRAM.

Prerequisites.—Any four of Courses 21-53, and 6 credits in addition selected from standard courses. A reading knowledge of French, German, or Greek is required of candidates for the Master's degree.

The degree of master of arts: For a major in Latin, Course 211-212-213, and in addition one course each quarter selected from Courses 121-133. The student will be expected to choose for his thesis some problem connected with one of these courses. Besides, a minor is to be carried throughout the year in one of the following departments: Comparative Philology, English, German, Greek, History, Romance Languages, or Scandinavian. For a minor in Latin, Course 201-202-203 or one course each quarter selected from Courses 121-133.

Candidates for the degree of doctor of philosophy in Latin will be expected to spend at least three years in preparation and will carry each quarter in addition to one seminar course and one of the courses listed below, one course in advanced Greek (i.e., in advance of two years of preparatory Greek). A knowledge of Greek and Roman history, Greek and Roman literature, and a special knowledge of a particular Latin author, or group of authors, will be required.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

121. ADVANCED VERGIL. Selection from Books 7-12 of the *Aeneid*. Prerequisites: any two of Courses 51-53 or an equivalent. Three credits. II; MWF; 109F. (Not offered in 1922-23.) MR. PIKE.

- 122W. CICERO'S LETTERS. Prerequisites: any two of Courses 51-53 or an equivalent. Three credits. II; MWF; 101F. MR. PIKE.
- 123S. MEDIEVAL LATIN. Selected documents illustrating the conflict between church and state in the Middle Ages. Selections from *History of the Franks*, by Gregory of Tours. Prerequisites: any two of Courses 51-53 or an equivalent. Three credits. II; MWF; 109F. MR. PIKE.
- 131f. JUVENAL. Selection from Juvenal's work. Prerequisites: any two of Courses 51-53 or an equivalent. Three credits. Alternates with Course 121. II; MWF; 107F. MR. PIKE.
132. SENECA'S EPISTLES. Prerequisites: any two of Courses 51-53 or an equivalent. Three credits. Alternates with Course 122. II; MWF; 107F. (Not offered in 1922-23.) MR. PIKE.
133. PETRONIUS AND VULGAR LATIN. Selections from Petronius and the *Peregrinatio Sanctae Silviae*. The relation of vulgar Latin to literary Latin will be discussed. Prerequisites: any two of Courses 51-53 or an equivalent. Alternates with Course 123. Three credits. II; MWF; 107F. (Not offered in 1922-23.) MR. PIKE.
- 201f-202W-203S. TACITUS. (Graduate seminar, but open to students who register for honors in Latin.) Prerequisites: seven years of Latin or any two of Courses 51-53. Three credits. VII, VIII; Th; 108F. MR. PIKE.
- 211-212-213. LUCRETIUS. (Graduate seminar, but open to students who register for honors in Latin.) Prerequisites: seven years of Latin or any two of Courses 51-53. Three credits. VII and VIII; Th; 108F. (Not offered in 1922-23.) MR. PIKE.

MATHEMATICS AND MECHANICS

Professors WILLIAM E. BROOKE, WILLIAM H. BUSSEY, WILLIAM F. HOLMAN, DUNHAM JACKSON, WILLIAM H. KIRCHNER, FRANCIS P. LEAVENWORTH (Astronomy); Associate Professors RAYMOND W. BRINK, HANS H. DALAKER, WILLIAM L. HART, ROYAL R. SHUMWAY, ANTHONY L. UNDERHILL;¹ Assistant Astronomer WILLIAM O. BEAL.

Professor R. W. Brink is chairman of the group. Students majoring in mathematics should consult him.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

Courses offered by members of the faculty of the College of Science, Literature, and the Arts.

106f-107W-108S. ADVANCED CALCULUS AND DIFFERENTIAL EQUATIONS. Three credits per quarter. III; MWF; 105F. MR. HART.

¹ Absent on leave, 1922-23.

111f-112w-113s. CELESTIAL MECHANICS. Three credits per quarter. MR. BEAL. (This course is identical with Astronomy 111-112-113.)

140w. METHOD OF LEAST SQUARES. Three credits. MR. LEAVENWORTH. (This course is identical with Astronomy 140.)

Courses offered by members of the faculty of the College of Engineering and Architecture.

127f,w,s. TECHNICAL MECHANICS. Five credits. MR. WILCOX.

128f,w,s. STRENGTH OF MATERIALS. Five credits. MR. HOLMAN.

129f,w,s. HYDRAULICS. Four credits. MR. HOLMAN.

151f-152w-153s. DIFFERENTIAL EQUATIONS AND ADVANCED CALCULUS APPLIED TO ENGINEERING PROBLEMS. Three credits per quarter. MR. HARTIG.

161f-162w-163s. ADVANCED TECHNICAL MECHANICS. Three credits per quarter. MR. WILCOX.

COURSES PRIMARILY FOR GRADUATE STUDENTS

Courses offered by members of the faculty of the College of Science Literature, and the Arts.

206f-207w-208s. THEORY OF FUNCTIONS OF REAL AND COMPLEX VARIABLES. Three credits per quarter. MR. JACKSON.

271f-272w-273s. THEORY OF LINEAR DIFFERENTIAL AND INTEGRAL EQUATIONS. Three credits per quarter. MR. BRINK.

Courses offered by members of the faculty of the College of Engineering and Architecture.

261f-262w-263s. ELLIPTIC FUNCTIONS WITH APPLICATIONS. Three credits per quarter. MR. DALAKER.

267f-268w-269s. ADVANCED DYNAMICS. Three credits per quarter. MR. BROOKE.

The following courses have been offered from time to time in the past, and similar courses, or other courses of corresponding grade, will be provided at any time when there is sufficient demand for them.

Courses offered by members of the faculty of the College of Science, Literature, and the Arts.

DIFFERENTIAL GEOMETRY.

PROJECTIVE GEOMETRY.

MODERN HIGHER ALGEBRA

THE MATHEMATICS OF SMALL VIBRATIONS.

THE THEORY OF NUMBERS.

THE GALOIS THEORY OF EQUATIONS.

HIGHER PLANE CURVES.

ADVANCED DIFFERENTIAL EQUATIONS.

EXTERIOR BALLISTICS.

THE CALCULUS OF FINITE DIFFERENCES.

MODERN THEORIES OF INTEGRATION.

APPROXIMATION BY POLYNOMIALS AND TRIGONOMETRIC SUMS.

Courses offered by members of the faculty of the College of Engineering and Architecture.

ADVANCED DESCRIPTIVE GEOMETRY.

PERSPECTIVE.

VECTOR ANALYSIS.

MODERN ANALYSIS.

FOURIER'S SERIES AND SPHERICAL HARMONICS.

MECHANICAL ENGINEERING

Professors JOHN J. FLATHER, WILLIAM S. HOLMAN, FRANK B. ROWLEY;
Associate Professors JOHN V. MARTENIS, CARL SHIPLEY, CHARLES F. SHOOP.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

110f. TOOL DESIGN. Three credits. MR. SHIPLEY.

111w. TOOL CONSTRUCTION. Three credits. MR. SHIPLEY.

131f-132w-133s. ADVANCED ENGINEERING DESIGN. Original design, including machinery for changing size and form, cranes, pumping, transmission machinery, and engineering appliances. Lectures, problems, and drawing room practice. Three credits per quarter. MR. FLATHER.

135f. STEAM ENGINE DESIGN. Three credits. MR. FLATHER.

136w. GAS ENGINE DESIGN. Three credits. MR. ROWLEY, MR. ROBERTSON,

144f. HEAT ENGINES. Elementary thermodynamics. Properties of steam. Types and details of steam engines. Three credits with three hours of laboratory a week. MR. ROWLEY, MR. SHOOP.

145w. HEAT ENGINES. Continuation of Course 144. Three credits with three hours of laboratory a week. MR. ROWLEY, MR. SHOOP.

146s. HEAT ENGINES. Elementary study of steam turbines and gas engines, Courses 144, 145, 146 are arranged for students in electrical engineering and are accompanied by three hours' work in laboratory each week. Three credits. MR. ROWLEY, MR. SHOOP.

150w. GAS ENGINES AND PRODUCERS. Laws of gases; gas cycles. Otto, semi-Diesel, and Diesel engines. Mechanism of various types. Principles of design. By-products recovery. Three credits. MR. ROWLEY.

- 151f. THERMODYNAMICS. The mechanical theory of heat as applied to steam, oil, gas, and hot air engines and allied power plant machinery and accessory equipment, including compressors, injectors, reheaters, and refrigerating apparatus. Three credits. MR. SHOOP.
- 152w. STEAM TURBINES. Theory and practice applied to various types. Laboratory investigation. Three credits. MR. SHOOP.
- 153s. HEATING AND VENTILATING. Principles of heating and ventilating. Construction and operation of heating apparatus. Lectures, recitations, and designs. Four credits. MR. MARTENIS.
- 156s. COMPRESSED AIR AND REFRIGERATING MACHINERY. Three credits. MR. ROWEN.
- 164w-165s. POWER PLANT MANAGEMENT. Operation and maintenance of boilers, engines, gas producers, gas engines, steam turbines, and accessory apparatus. Smoke prevention. Flue gas analysis. Daily logs and power costs. Three credits per quarter. MR. ROWEN.
- 166w. WATER TURBINES. The theory of operation, design, construction, and regulation of water turbines. Turbine-testing; characteristics, selection of type. Cost of turbines and water power. Three credits. MR. ROWEN.
- 181w. ADVANCED GENERAL LABORATORY. Indicator practice, valve-setting, separating and throttling calorimeter, tests of steam engines, gas engines, pumps, air compressors, blowers, turbines, boilers, and power plant. Four actual hours. MR. ROWLEY, MR. SHOOP.
- 182f. ADVANCED STEAM LABORATORY. Tests of steam turbines, flow of steam through nozzles and pipes. Tests of compounds and triple expansion engines, condensers, superheaters, and boilers. Two credits. MR. SHOOP.
- 183w. POWER AND GAS ENGINE LABORATORY. Tests of gas, gasoline, and hot air engines, gas producers. Power and lighting plants. Two credits. MR. ROWLEY, MR. ROBERTSON.
- 184s. ADVANCED ENGINEERING LABORATORY. Opportunity will be offered for carrying on investigations in connection with tests of power plants, refrigerators, air compressors, blowers, and fans. Also automobile-testing and gas engine investigations. Two credits. MR. ROWLEY, MR. SHOOP.
- 190f-191w-192s. SEMINAR. Reading of assigned articles in current technical press. Preparation of synopsis and preparation of principal features. Arranged for seniors. One credit per quarter. MR. FLATHER, MR. ROWLEY.

- 193s. **ENGINEERING PRACTICE.** Engineering relations, legal and ethical, collaboration and consultation; technical reports, investigation, and estimates. Professional employment, ownership of plans; patents and rights of invention. Day labor and contract systems of construction; public and private works, arbitration. Two credits. MR. FLATHER.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 223f. **INDUSTRIAL MANAGEMENT.** Shop and factory organization and management; cost and wage systems. Depreciation of equipment. Machine burden. Time studies. Three credits. MR. FLATHER.
- 224w. **INDUSTRIAL MANAGEMENT LABORATORY.** An advanced course in shop practice with especial reference to production. Time studies; stores and follow-up systems. Investigations in local factories. Three credits. MR. FLATHER.
- 225s. **INDUSTRIAL MANAGEMENT PROBLEMS.** Special investigations of practical problems and suggested methods of procedure. Three credits. MR. FLATHER.
- 226w. **SAFETY ENGINEERING.** A study of the methods employed to promote safety in the factory; workmen's compensation laws. Two credits. MR. FLATHER.
- 237s. **GAS TRACTOR DESIGN.** Three credits. MR. ROWLEY.
- 255f,w,s. **ADVANCED HEATING AND VENTILATING.** To be taken in connection with research work in the laboratory, Course 287. Three credits. MR. ROWLEY.
- 257s. **MECHANICAL EQUIPMENT OF BUILDINGS.** Choice of systems. Theory and practice of designing and detailing layouts. Equipment designs for various types of buildings. Three credits. MR. ROWLEY, MR. MARTENIS.
- 262f. **POWER ENGINEERING.** Advanced study and application of engines, stokers, boilers, coal-handling equipment and accessories. Lay-out of manufacturing shops. Routing of work, transmission systems and selection of motors, factory lighting and heating. Lectures, recitations, drawing room work. Three credits. MR. ROWEN.
- 266w-267s. **POWER PLANT DESIGN.** Problems, designs, and estimates for power plant and central stations. Selection of motive powers, relative advantages of steam and producer gas plants, choice of engines and boilers; pumps, shafting, piping, and accessories. Three credits per quarter. MR. ROWEN.
- 271f. **RAILWAY TECHNOLOGY.** The practical details of construction of locomotives. A systematic course of visits to the various railroad shops in the vicinity. Lectures and recitations. One credit.

- 272f-273w-274s. RAILWAY DESIGN AND LOCOMOTIVE CONSTRUCTION. Locomotive and car details; the locomotive boiler, linkages, and assembled parts. Construction of locomotives; engine details. Lectures and assigned reading. Four credits. MR. FLATHER.
- 278s. LOCOMOTIVE ROAD-TESTING. Tests on locomotives and trains. Dynamometer car and drawbar pull. Three credits. MR. FLATHER and assistants.
- 287-288-289. ENGINEERING RESEARCH. Courses may be elected which involve investigations in connection with lubrication, steam and gas engines, heating and ventilating, and other problems as selected. Reports, special problems, and related tests. Three to 9 credits per quarter. MR. FLATHER, MR. ROWLEY, MR. SHOOP, MR. ROWEN.
- 293w. AERONAUTICAL ENGINEERING. Design of aerial propellers, aeroplane engines. Application of theory of propellers and gasoline engines to aeroplanes. Includes calculations and drawings for high speed multi-cylinder light weight engine; balancing reciprocating parts; uniform torque; theoretical diagrams. Three credits.
294. AEROPLANE DESIGN. Calculations and drawings for a given aeroplane; stability, strength, propulsion, and motive power required. Three credits.
- GE101w. CONTRACTS AND SPECIFICATIONS. A study of engineering specifications. Lectures, recitations, and practice in writing specifications. Three credits. MR. FLATHER.

MEDICINE

(Including General Medicine, Dermatology, and Nervous and Mental Diseases)

The graduate work in the Department of Medicine is designed to prepare students for practice of the specialty of internal medicine, research in the problems of general medicine, and for the specialty of nervous and mental diseases, as the case may be, and to train men as teachers in their respective fields. Prospective students who have had no special work in addition to that of the undergraduate course in physiology, physiologic chemistry, therapeutics, experimental medicine, or pathology are advised to devote a year or more to these subjects before entering the regular three-year graduate course. Throughout the course it is recommended that a minor be carried in one or more of the following departments: Physiology, Pharmacology, Pathology, Immunology, and Pediatrics. For students specializing in nervous and mental diseases, minors in anatomy and psychology are especially valuable, and for those desiring it, work would be arranged in the Department of Ophthalmology and Oto-Laryngology, giving a special opportunity to study lesions of the eye occurring in systematic disorders. In the Medical School, during at least the third year of the

three-year fellowship, the fellow acts as an officer of the clinic with definite responsibility in the care of patients in the University Hospital.

For courses of study see special bulletin of graduate courses in medicine.

METALLOGRAPHY

Associate Professor OSCAR E. HARDER.

Prerequisites.—For major work, adequate preparation in the sciences fundamental to metallography (chemistry, physics, geology, technical subjects), the general requirements being fulfilled. For minor work, the prerequisites to the courses to be pursued.

Exemption from the language requirements for the Master's degree may be made in individual cases.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 150f. METALLOGRAPHY FOR ELECTRICAL ENGINEERS. Principles of metallography, including pyrometry, thermal analysis, constitution diagrams, microscopic and photomicrographic technique; study of typical alloys with special reference to electrical resistance, conductivity, magnets, etc. Laboratory work and demonstrations. Two lectures, three laboratory hours per week. Three credits. I; MW; 112M. VI, VII, VIII; M; 307M. MR. HARDER, MR. DOWDELL.
- 151W. ADVANCED METALLOGRAPHY FOR ELECTRICAL ENGINEERS. Continuation of 150. Two lectures, three laboratory hours per week. Prerequisite: Course 150. Three credits. I; MW; 112M. VI-VIII; M; 307M. MR. HARDER, MR. DOWDELL.
- 153f-154W-155S. METALLOGRAPHY. (Long course for metallurgical engineers.) Theory of metallic alloys. Metallographic technique. Properties of metals and alloys. Metallography of iron and steel and commercial alloys. Technical metallography. Three lectures, four laboratory hours per week each quarter. Prerequisites: Chemistry 20, Physics 5. Five credits per quarter. VI or VII; MWF; 305M. VI-IX; T; 307M. MR. HARDER, MR. DOWDELL.
- 156f. METALLOGRAPHY FOR MECHANICAL ENGINEERS. Similar to 150 but specially arranged for students in mechanical engineering. Two lectures, three laboratory hours per week. Three credits. III; MTh; 108M. VI-VIII; W or F; 307M. MR. HARDER, MR. DOWDELL.
- 157W. ADVANCED METALLOGRAPHY FOR MECHANICAL ENGINEERS. Continuation of 156. Two lectures, three laboratory hours per week. Three credits. Prerequisite: Course 156. III; MTh; 108M. VI-VIII; W or F; 307M. MR. HARDER, MR. DOWDELL.
- 160f. METALLOGRAPHY FOR CHEMICAL STUDENTS. Principles of metallography, including constitution diagrams, preparation and standardization of thermocouples, preparation and thermal analysis of alloys,

microscopic examination and making of photomicrographs; typical alloy systems as iron-carbon (steel and cast iron), some non-ferrous alloys. Prerequisite: Chemistry 20. Two lecture and two laboratory hours per week. Three credits. II; MW; 305M. VI, VII; Th; 307M. Mr. HARDER, Mr. DOWDELL.

161W. ADVANCED METALLOGRAPHY FOR CHEMICAL STUDENTS. Metallography and heat treatment of iron and steel, including alloy steels, commercial uses of various steels, and engineering specifications. Prerequisite: Course 160. Two lectures and two laboratory hours per week. Three credits. II; MW; 305M. VI, VII; Th; 307M. Mr. HARDER, Mr. DOWDELL.

162S. ADVANCED METALLOGRAPHY FOR CHEMICAL STUDENTS. Metallography of the non-ferrous metals with a study of the constitution diagrams, properties, and uses of important commercial alloys. Prerequisite: Course 160. Two lecture and two laboratory hours per week. Three credits. II; MW; 305M. VI-VII; Th; 307M. Mr. HARDER, Mr. DOWDELL.

163f-164W-165S. ADVANCED METALLOGRAPHY. Technical and scientific research. The study of steel rails, automobile and locomotive parts, tool steels, etc. Special problems in metallography with outside reading. Seminar work in the recent advances in metallography. Prerequisites: Courses 151, 155, 157, or equivalent. Credits and hours to be arranged. 305M. Mr. HARDER.

COURSES PRIMARILY FOR GRADUATE STUDENTS

201f-202W-203S. ADVANCED METALLOGRAPHY FOR GRADUATE STUDENTS. Intended primarily for research work. Credits and hours to be arranged. 305M. Mr. HARDER.

OBSTETRICS AND GYNECOLOGY

For staff and courses of study offered, see special bulletin of graduate work in medicine.

OPHTHALMOLOGY AND OTO-LARYNGOLOGY

For staff and courses of study offered, see special bulletin of graduate work in medicine.

PATHOLOGY

Prerequisites.—Graduate students who desire to take their major or minor work in pathology must present credits in the following subjects: physics, 8 credits; general and organic chemistry, 12 credits; zoology, 6 credits; and a reading knowledge of German.

In addition, students who elect their major work in pathology must present credits for the equivalent of the first two years' work of the Medical School of this University.

For staff and courses of study offered, see special bulletin of graduate work in medicine.

PEDIATRICS

For staff and courses of study offered, see special bulletin of graduate work in medicine.

PHARMACOLOGY AND THERAPEUTICS

For staff and courses of study offered, see special bulletin of graduate work in medicine.

PHILOSOPHY

Professors NORMAN WILDE, DAVID F. SWENSON; Assistant Professor GEORGE P. CONGER.

Prerequisites.—For a major, 18 credits; for a minor, 9 credits of work in the department are prerequisites.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 100f-101w-102s. PHILOSOPHY OF RELIGION. Religion as an interpretation and evaluation of life. Fall quarter: survey of historical and psychological phenomena of various religions; winter and spring quarters: critical discussion of esthetic, ethical, and religious attitudes toward life, including a presentation of speculative idealism and the philosophy of Christianity as a transcendental ethical religion. Prerequisites: 10 credits. Nine credits. II; TThS; 322F. MR. SWENSON.
- 104s. HISTORY OF ESTHETICS. A survey of the chief esthetic theories of ancient and modern thinkers. Prerequisites: 10 credits. Three credits. II; MWF; 322F. MR. SWENSON.
- 108w-109s. HISTORY OF ETHICS. Survey of the chief ideals of conduct from Socrates to the present day. Prerequisites: 15 credits in any social science or 10 in philosophy. Six credits. (Not offered in 1922-23.)
- 120w. SCANDINAVIAN PHILOSOPHY. The philosophical thought of the nineteenth century in Scandinavian countries, including a comparative study of Boström and Kierkegaard. Prerequisites: 10 credits. Three credits. 2-3:30; TTh; 316F. MR. SWENSON.
- 124f. POLITICAL AND SOCIAL ETHICS. The fundamental aspects of society and the state, considered from the point of view of ethics. Prerequisites: 20 credits in any social science, or 10 in philosophy. Five credits. I; T-S; 322F. MR. WILDE.

- 129w. MODERN POLITICAL THOUGHT. The state in modern political philosophy, its nature, basis, and authority. Individualism and socialism in the eighteenth and nineteenth centuries. The idea of democracy. Prerequisites: 10 credits in philosophy or 20 in any social science. Five credits. I; T-S; 322F. MR. WILDE.
- 135f-136w. THE PHILOSOPHY OF PLATO. Prerequisites: 10 credits. Four credits. (Not offered in 1922-23.) MR. CONGER.
- 141f. METAPHYSICS. Prerequisites: 10 credits including Philosophy 2. Three credits. (Not offered in 1922-23.) MR. SWENSON.
- 147f. ADVANCED LOGIC. Different topics from year to year, including the organization of the sciences, the presuppositions of knowledge, recent mathematical and symbolic logic, and the pragmatic theory of logic. Prerequisites: 10 credits including Philosophy 2. Three credits. 2-3:30 TTh; 316F. MR. SWENSON.
- 151f-152w. MODERN IDEALISM. The place of mind in the world as discussed by philosophers from Kant to Royce. Prerequisites: 15 credits in philosophy. Four credits. VII; TTh; 316F. MR. CONGER.
- 161f-162w-163s. SEMINAR IN PHILOSOPHY. Individual investigation in philosophy. Studies in either ancient or modern philosophy and ethics; critical and constructive studies of logic, metaphysics, or ethics. Character of work and general topics for year ascertained by consultation with department. Prerequisites: 20 credits in philosophy. Nine credits. MR. WILDE, MR. SWENSON, MR. CONGER.

PHYSICS

Professors HENRY A. ERIKSON, W. FRANCIS G. SWANN, JOHN T. TATE, ANTHONY ZELNY; Assistant Professors LQUALLEN F. MILLER, JOSEPH VALASEK.

Prerequisites.—For major work, differential and integral calculus and two years of physics of college grade. For minor work, one year of college physics.

A student majoring in physics is required to take Courses 101 to 111 and 102 to 112 inclusive unless excused by the department upon satisfactory evidence through examination at entrance. A course of general reading as outlined by the department in each individual case is also required.

For the Master's degree a reading knowledge of French or German is required. It is desirable that this requirement be fulfilled before graduate work is begun.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f-103w-105s-107f-109w-111s. THEORETICAL PHYSICS. Designed to supplement the general course and to prepare the student for the more specialized graduate courses. Four lectures a week. Prerequisites:

- Courses 21, 31, 41, Mathematics 51. Twelve credits. IV; MTWF; 2Ph. MR. TATE.
- 102f-104w-106s-108f-110w-112s. EXPERIMENTAL PHYSICS. Comprehensive course extending through two years; laboratory technique and standard methods of precise measurements. This course may be begun any quarter. Two three-hour sessions a week. Prerequisites: Courses 22, 32, 42. Three credits per quarter. (1) V-VII; MW; 2Ph. (2) V-VII; TTh; 2Ph. MR. TATE, MR. ZELENY, MR. MILLER, MR. POWER, MR. VALASEK.
- 115f-117w-119s. ELEMENTS OF MATHEMATICAL PHYSICS. Standard methods involved in the mathematical analysis of physical problems. Three lectures a week. Prerequisites: Course 105, Mathematics 51. Nine credits.
- 114f-116w-118s. ELEMENTARY PHYSICAL INVESTIGATION. Two three-hour sessions a week. Nine credits. Prerequisites: Course 106, Mathematics 51. Under direction of individual members of staff.
- 122s. PYROMETRY AND HEAT. Prerequisites: Courses 22 and 42. Three credits. One lecture and 2 three-hour sessions in the laboratory a week. V-VIII; TTh; 9Ph. MR. MILLER.
- 132w. APPLIED OPTICS. Experimental work on special optical problems. Prerequisite: Course 32. Two three-hour laboratory periods a week. Three credits. VII-VIII; TTh; 3Ph. MR. VALASEK.
- 142f. ELECTRICAL MEASUREMENTS. Prerequisite: Course 42. Three credits. Three two-hour laboratory sessions a week. See engineering program. MR. ZELENY.
- 146w. ELECTRICAL MEASUREMENTS OF PRECISION. Three two-hour laboratory periods a week. Prerequisite: Course 142. Three credits. MR. ZELENY.
- 145f-147w-148s. RADIOACTIVITY MEASUREMENTS. Prerequisites: Course 106, Mathematics 51. Nine credits. V-VII; TTh; 15Ph. MR. ERIKSON.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f. ADVANCED ANALYTICAL MECHANICS. Kinematics of particles and of rigid bodies; the general principles of dynamics and their application to the motion of particles and of rigid bodies. Application to non-mechanical problems. Three lectures a week. Prerequisite: Physics 101-103-105, Mathematics 51. Three credits. MR. TATE.
- 203w. THEORY OF ELASTICITY. Analysis of strain and stress; equations of wave motion; applications to sound and to electromagnetic oscillations. Three lectures a week. Prerequisite: Physics 201. Three credits. MR. TATE.

- 205s. **HYDRODYNAMICS.** Equations of Euler and Lagrange. Application to special types of fluid motion; motion of viscous fluid. Three lectures a week. Prerequisite: Physics 201. Three credits. MR. TATE.
- 221f. **THERMODYNAMICS: KINETIC THEORY OF GASES.** Classical thermodynamics and applications to special problems: statistical mechanics; relation to thermodynamics; theory of effusion, specific heats, dissociation, viscosity, conduction of heat, diffusion, transfer problems in general. Three lectures a week. Prerequisites: Physics 101-103-105; Mathematics 51. Three credits. MR. TATE.
- 223w. **THEORY OF THERMAL RADIATION.** Application of thermodynamics and statistical mechanics to thermal radiation; Planck's quantum hypothesis and applications to specific heats and allied problems. Three lectures a week. Prerequisites: Physics 221. Three credits. MR. TATE.
- 225s. **THEORIES OF ATOMIC STRUCTURE.** The quantum theories and their application to the study of X-rays, radioactivity, resonance and ionization potentials, photo-electricity; spectrum series and fine structure; resonance spectra; Stark effect. Three lectures a week. Prerequisites: Physics 221-223. Three credits. MR. TATE.
- 231f-233w-235s. **THEORETICAL OPTICS.** Geometrical optics and optical instruments. Theory of interference, diffraction, and polarization. Electron theory of dispersion, absorption, double refraction, optical rotation, magneto- and electro-optics. Radiation and its transformation and resonance radiation. Theory of moving media. Three lectures a week. Prerequisites: Physics 101-103-105, Mathematics 106-107-108. MR. VALASEK.
- 241f-243w. **MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM.** Fundamental mathematical theorems and processes of analysis applicable to potential theory; electric images; polarized media; magnetism; magnetic shells and their relation to electric currents; current flow in waves and infinite media; dynamical theory of electromagnetism. Three lectures a week. Prerequisites: Physics 101-103-105. Mathematics 106-107-108. Six credits. MR. SWANN.
- 242f-244w. **THEORY OF ELECTRIC OSCILLATIONS.** Fundamental laws of electrodynamics; free and forced vibrations in electrical circuits, tuning, damping; theory of radio instruments; energy losses in coils, condensers, etc.; electron tubes and circuits containing them; electromagnetic radiation. Three lectures a week. Prerequisites: Physics 101-103-105, Mathematics 106-107-108. Six credits. MR. SWANN.
- 245s. **FUNDAMENTALS OF ELECTRON THEORY.** The Maxwell Lorentz equations; solutions in terms of retarded potentials; equations expressing conservation of energy and momentum; electromagnetic mass; systems

in uniform rectilinear motion; radiation from electrons. Three lectures a week. Prerequisites: Physics 231-243. Three credits. MR. SWANN.

246s. MEASUREMENTS OF ELECTRICAL OSCILLATIONS. Determination of characteristic curves of electron tubes; use of wave meter; measurement of high frequency resistance; verification of the laws of oscillating circuits in general. Three two-hour laboratory sessions a week. Prerequisites: Physics 242-244. Three credits. MR. SWANN.

247f. THEORY OF RELATIVITY. Historical survey; the special theory; Minkowski's four dimensional analysis; application to electromagnetic theory; determination of equations of motion of electrons and to gravitation; the general theory; theory of tensors; Einstein's law of gravitation with application. Three lectures a week. Prerequisites: Physics 241-243-245, Mathematics 106-107-108. Three credits. MR. SWANN.

248w-249s. ELECTRON THEORY OF MATTER. Conduction of electricity in metals and allied phenomena; electromagnetic theory and heat radiation; thermionics; atomic structure; theory of diamagnetism; theory of paramagnetism; Weiss's theory of ferromagnetism. Three lectures a week. Prerequisite: Physics 247. Six credits. MR. SWANN.

252f-254w-256s. RESEARCH. Under the special direction of individual members of the staff.

261f-263w-265s. SEMINAR. Study of present-day problems in physics. One hour a week. Open to those who are doing graduate work in physics. Three credits. MR. TATE.

PHYSIOLOGY AND PHYSIOLOGIC CHEMISTRY

Prerequisites.—The Department of Physiology is well equipped for the various types of physiologic investigation. The library facilities are good.

For a minor in physiology, general zoology, general and organic chemistry, and college physics are prerequisites. (In exceptional cases high school physics may be accepted.) For a major, physical chemistry is desirable.

In addition, each student majoring in physiology or physiologic chemistry must have had the general courses, Physiology 100, 101, 103, 104, or the equivalent.

For staff and courses of study offered, see special bulletin of graduate work in medicine.

PLANT PATHOLOGY AND BOTANY

Professors EDWARD M. FREEMAN, ELVIN C. STAKMAN.

NOTE.—For courses in botany including plant physiology see Department of Botany.

Prerequisites.—The minimum requirement is (a) three years (27 credits) in botany, one year (9 credits) of which shall be mycology; (b) general bacteriology one quarter (4 credits) or some equivalent; (c) one year (9 credits) in plant pathology—preferably two years (18 credits).

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

105f-106w-107s. MYCOLOGY. Morphology, taxonomy, and biology of fungi. Lecture, laboratory, greenhouse, and field work. Prerequisites: Botany 7 and 11 or equivalent. Three credits per quarter. MISS DOSDALL.

108f. METHODS. Plant pathological methods, including mycological and bacteriological technique. Lectures, laboratory, field, and greenhouse work. Special problems. Prerequisites: Course 1 or 10 and Bacteriology 6. Three credits per quarter. MR. LEACH.

110w. PRINCIPLES OF PATHOLOGY. Comparative biology of plant pathogens; pathological plant anatomy, parasitism, biologic specialization, resistance, and immunity. Prerequisites: Course 1 or 10 and Bacteriology 6. Three credits. MR. STAKMAN, MR. BARKER.

111w,su. DISEASES OF FIELD CROPS. Symptomatology, etiology, and practical methods of control. Laboratory, lecture, and field work. Prerequisite: Course 1 or 10. MR. STAKMAN, MR. BARKER.

*112s. DISEASES OF FRUIT CROPS. Especially those important in Minnesota. Laboratory, lecture, and greenhouse work. Three credits. MR. LEACH.

*113s. DISEASES OF VEGETABLE CROPS. Diseases of potatoes and other vegetable crops. Lecture, reference, laboratory, and greenhouse work. Three credits. MR. LEACH.

114w. ADVANCED FOREST PATHOLOGY. Wood rots, including a study of the deterioration of wood products caused by fungi. Lectures, laboratory, and greenhouse work. Three credits. MR. STAKMAN, MR. LEACH.

COURSES PRIMARILY FOR GRADUATE STUDENTS

203f-204w-205s. SPECIAL PROBLEMS. Special assignment of work in laboratory and field problems in pathological research. MR. FREEMAN, MR. STAKMAN.

207f-208w-209s. RESEARCH IN MYCOLOGY. Research work along following suggested lines: taxonomy of natural groups; fungous flora of particular regions, localities, or habitats; investigation of fungi involved in special industrial or natural processes; morphology or physiology of special forms. Prerequisite: Course 105-106-107. For minor or major. Three credits per quarter. MR. FREEMAN, MR. STAKMAN.

* These courses will be given only in alternate years, except by special arrangement.

211. HISTORY OF PLANT PATHOLOGY. Development of important mycological, pathological, and physiological researches; historical basis of modern science of plant pathology. Two credits per quarter. MR. STAKMAN.
213. SEMINAR. Assigned topics with special reference to current pathological problems. Historical review of literature on special problems and critical study of current literature. Two credits per quarter. MR. STAKMAN.

POLITICAL SCIENCE

Professors CEPHAS D. ALLIN, FREDERIC H. BASS (Engineering), ROBERT E. CUSHMAN, QUINCY WRIGHT, JEREMIAH S. YOUNG, ROY G. BLAKEY¹ (Economics), SOLON J. BUCK (History), ALBERT B. WHITE (History), NORMAN WILDE (Philosophy); Associate Professors WILLIAM ANDERSON, ALVIN H. HANSEN (Economics), LESTER B. SHIPPEE (History), MASON W. TYLER (History); Assistant Professors MORRIS B. LAMBIE, HAROLD S. QUIGLEY.¹

Prerequisites.—For major work, 18 credits; for minor work, 13 credits.

Professional courses.—The attention of those who are preparing themselves for the public service is called to the special training courses outlined in the bulletin of the College of Science, Literature, and the Arts. Further information may be had from the chairman of the department.

Bureau for Research in Government.—This bureau is organized to conduct and direct special investigations into practical political and administrative problems, national, state, and local. Mr. Anderson will act as director, but all members of the staff will take part in the work of the bureau. Advanced and graduate students are strongly urged to take advantage of its facilities.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 107-108. EUROPE, 1848-1914. Identical with History 107-108. Prerequisites: 10 credits. A reading knowledge of French or German will be helpful. MR. TYLER.
109. ENGLISH HISTORY, 1815-1920. Identical with History 109-110.
115. MUNICIPAL PROBLEMS. A specialized course in modern legal, administrative and functional problems of cities. II; MWF; 213MA. MR. ANDERSON.
117. MUNICIPAL ENGINEERING. Identical with Civil Engineering 53.3. MR. BASS.
- 121-122. INTERNATIONAL LAW. With especial attention to diplomatic and consular practice. IV; MTWF; 213MA. MR. WRIGHT.

¹ On leave of absence, 1922-23.

123. INTERNATIONAL ORGANIZATION. Systems of international relations, International administrative organizations, and political guarantees of the past with a detailed study of the League of Nations. (Not offered in 1922-23.) MR. WRIGHT.
124. PROBLEMS IN INTERNATIONAL LAW. Intensive study of the solution of selected international controversies by national and international courts, arbitration tribunals, and diplomatic conferences. IV; MTWF; 213MA. MR. WRIGHT.
125. AMERICAN DIPLOMATIC HISTORY. Principles and policies guiding American diplomacy in its stages of development as well as to the methods pursued and the personalities of American diplomats. III; MTWF; 213MA. MR. WRIGHT.
127. AMERICAN FOREIGN RELATIONS. Such topics as the Monroe Doctrine, freedom of the seas, the "open door," arbitration, and disarmament will be considered with particular reference to the future policy of the United States. III; MTWF; 213MA. MR. WRIGHT.
129. FAR EASTERN POLITICS. The principal factors in the social and political life of Japan and China; their relations with each other and with western powers. (Not offered in 1922-23.) MR. QUIGLEY.
- 131-132. PUBLIC ADMINISTRATION. Sources of administrative power; administrative areas; organization of departments; personnel, and related civil service problems including classification, training, appointment, promotion, salary determination and superannuation; the budget; purchasing; control over administration; public service as a career. IV; MWF; Ar. MR. LAMBIE.
133. PROBLEMS OF PUBLIC ADMINISTRATION. Organization of departments and distribution of functions relating to particular problems of public administration including public health, finance, education, public works, safety, welfare, commerce, and agriculture. IV; MWF; 109MA. MR. LAMBIE.
141. PROBLEMS IN STATE GOVERNMENT AND CONSTITUTIONAL LAW. A selected group of current problems in state government will be studied intensively in their constitutional and political aspects. VI; MWF; 213MA. MR. CUSHMAN.
145. LEGISLATIVE POWER AND METHODS. Source and scope of the legislative power; methods used by legislative bodies; current political questions; formulation and defense of legislative bills. II; TThS; 102MA. MR. YOUNG.
- 146-147.† CONSTITUTIONAL HISTORY OF THE UNITED STATES. Identical with History 146-147. MR. SHIPPEE.
151. CONSTITUTIONAL LAW: THE AMERICAN FEDERAL SYSTEM. Judicial interpretation of the constitution; power of judicial review; separation

- of governmental powers; relation of state and national governments; construction of national powers; jurisdiction of courts. VII; MWThF; 109MA. MR. CUSHMAN.
152. CONSTITUTIONAL LAW: FUNDAMENTAL RIGHTS AND IMMUNITIES. Privileges and immunities of citizenship; protection of civil and political rights; the obligation of contracts; due process of law and equal protection of the law. VII; MWThF; 209MA. MR. CUSHMAN.
153. THE WEST IN AMERICAN POLITICS SINCE 1865. Identical with History 153. (Not offered in 1922-23.) MR. BUCK.
155. COMPARATIVE ADMINISTRATIVE LAW. Administration as a science; analysis of the administrative systems of the United States, England, France, and Germany with special reference to the law of officers, the merit system, and special administrative tribunals. (Not offered in 1922-23.) MR. YOUNG.
157. POLICE POWER. Nature of the police power; constitutional aspects of social and economic legislation, including safety, order, morals, and protection against business fraud and oppression; the fundamental rights under the police power. II; TThS; 102MA. MR. YOUNG.
158. GOVERNMENT AND BUSINESS. Governmental powers; protection against fraud and oppression; restraint of trade and manipulation of prices; protection of debtors; business affected with a public interest; combination of laborers; corporations; compulsory benefits; conservation of natural wealth; vested rights; confiscatory legislation. II; TThS; 202MA. MR. YOUNG.
161. COMPARATIVE FEDERAL GOVERNMENT. Ancient and modern federal unions. IV; MTWF; Ar. MR. ALLIN.
165. LAW AND CUSTOM OF THE ENGLISH CONSTITUTION. Legal and political aspects of the English constitution. II; MWF; Ar. MR. ALLIN.
166. GOVERNMENT OF THE ENGLISH EMPIRE. Organization, working and international status of the Imperial and Dominion governments. II; MWF; Ar. MR. ALLIN.
167. BRITISH POLITICS. Parties, party leaders, and policies. The relation of English and imperial policies. II; MWF; Ar. MR. ALLIN.
169. THE LABOR AND SOCIALIST MOVEMENT IN EUROPE. Identical with Economics 169. MR. HANSEN.
171. MUNICIPAL CORPORATIONS. The legal basis of municipal government; the relation of the city to the state; home rule. The city as a legal entity; its powers, duties, and liability for torts. II; MWF; 213MA. MR. ANDERSON.
181. MODERN POLITICAL THOUGHT. Same as Philosophy 129. I; TThS; 322F. MR. WILDE.

185. POLITICAL AND SOCIAL ETHICS. Same as Philosophy 124. I; TWThFS; 322F. MR. WILDE.

191-192. PUBLIC FINANCE. Identical with Economics 191-192. (Not offered in 1922-23.) MR. BLAKEY.

193. STATE AND LOCAL TAXATION. Identical with Economics 193. (Not offered in 1922-23.) MR. BLAKEY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

201-202-203. SEMINAR IN PUBLIC LAW, MR. YOUNG AND OTHERS.

211-212-213. SEMINAR IN MODERN GOVERNMENT AND POLITICAL THEORY. MR. ALLIN and others.

221-222-223. SEMINAR IN LOCAL GOVERNMENT AND ADMINISTRATION. MR. ANDERSON AND OTHERS.

NOTE.—A student registered in a seminar course will be expected to complete a satisfactory piece of research before receiving credit for the course. The Bureau for Research in Government is designed to give all possible assistance in the conducting of such research, but is not intended to relieve the student of his personal responsibility.

PSYCHOLOGY

Associate Professors RICHARD M. ELLIOTT, WILLIAM S. FOSTER, KARL S. LASHLEY, DONALD G. PATERSON, HERBERT WOODROW; Lecturer HARRY M. JOHNSON.

Prerequisites.—For either major or minor work, 12 credits.

101f-102w†-103s. EXPERIMENTAL PSYCHOLOGY. The theory and technique of the leading methods of experimental investigation in human psychology. Individual minor research problems in the third quarter. One lecture, four laboratory hours per week. Six or nine credits. VII; MWF; VIII; WF; 116Psy. MR. WOODROW, MR. JOHNSON.

108f-109w.† ADVANCED GENERAL PSYCHOLOGY. The laws of the normal, adult mind, based upon the study of experimental results. Lectures, recitations, and reports. Six credits. VIII; M. IX; MW; 116Psy. MR. JOHNSON.

114w-115s.† HUMAN BEHAVIOR. An analysis of the development and organization of human behavior. Consciousness or mind, as properties of the living body, are discussed in their dependence upon response. Six credits. II; TThS. 109Psy. MR. ELLIOTT.

121f-122w†-123s. NEUROPSYCHOLOGY. The functions of the nervous system in behavior. Neural basis of reflex, instinct, and habit. Physiology of motivation. Individual investigation of special problem in third quarter. One lecture and five laboratory hours per week. Six or nine credits. VII; VIII; MWF; 109Psy. MR. LASHLEY.

- 124f. PSYCHOLOGY OF LEARNING. Critique of current theories concerning the nature of the learning process. Problems and methods bearing upon the physiology of learning. Not open to students who take Neuropsychology. Three credits. IV; MWF; 109 Psy. MR. LASHLEY.
- 125f-126w.† PSYCHOLOGY OF INDIVIDUAL DIFFERENCES. Experimental and statistical study of the influence of sex, race, immediate ancestry, and environment in the causation of individual differences in mental traits. Each student participates in investigation of problems and in analysis of results. Six credits. II; MWF; 109Psy. MR. PATERSON.
- 127s. PSYCHOLOGICAL ANALYSIS OF SOCIAL INSTITUTIONS. An examination of the behavior of men in groups, and of some important social institutions, as determined by human motives and traditions. Three credits. II; MWF; 109Psy. MR. BIRD.
- 135f-136w.† DYNAMIC PSYCHOLOGY. The constituents of character; their development, their interrelationship, and their rôle in the determination of human affairs. Six credits. III; TThS; 109Psy. MR. WOODROW.
- 144w-145s.† ABNORMAL PSYCHOLOGY. Systematic review of psychiatry in relation to normal behavior. Types of social maladjustment; delinquency, criminality, fanaticism. Psychology of creative ability. The organization of personality as revealed by studies in psychopathology. Six credits. IV; MWF; 109Psy. MR. LASHLEY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 200f-201w.† SEMINAR IN THE HISTORY OF PSYCHOLOGY. Selected topics from the history of psychology. Open to advanced students with permission of the instructor. Three or six credits in proportion to work done. MR. FOSTER.
- 205s. ADVANCED DIFFERENTIAL PSYCHOLOGY. Three credits. MR. PATERSON.
- 206-207-208. RESEARCH IN ANIMAL BEHAVIOR.
- 210f-211w-212s. RESEARCH PROBLEMS. Laboratory investigations. Open to graduate students only. MR. ELLIOTT, MR. FOSTER, MR. LASHLEY, MR. PATERSON, MR. WOODROW, MR. JOHNSON.
- 215f-216w-217s.† SEMINAR IN PHYSIOLOGICAL PSYCHOLOGY. Fortnightly meetings attended by teaching staff and advanced students for discussion of some of the fundamental problems of behavior and for reports of research in progress in the laboratory. Three credits. Alternate Th. 7:15-9:15 p.m. MR. LASHLEY.
- 220f-221w-222s.† JOURNAL CLUB AND SEMINAR. Advanced students meet every other week for reports on current publications and discussion of contemporary trends in psychology and related sciences. Attendance of graduate students who are candidates for degrees is required. One credit per quarter.

ROMANCE LANGUAGES

Professors EVERETT W. OLMSTED, IRVILLE C. LeCOMPTE, COLBERT SEARLES; Associate Professor RUTH S. PHELPS; Assistant Professors FRANCIS B. BARTON,¹ JOSEPH E. GILLET, EUGENE F. PARKER, EDWARD H. SIRICH, GUSTAVE VAN ROOSBROECK; Professorial Lecturer, ANTONIO HERAS.

Prerequisites.—For major work, 27 Senior College credits or equivalent; for minor work, 18 Senior College credits or equivalent. Candidates for Master's degree must also have a reading knowledge of at least one other modern language. Candidates for the Doctor's degree must have had at least two years' work in Latin, and are required to take also the course in medieval Latin in the Latin Department. A reading knowledge of a second Romance language and of German is also required.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

FRENCH

100W-101S. DICTION FRANÇAISE. Dissertations littéraires par le discours. Leçons sur des textes en prose et en vers. Exercices oraux de diction, de syntaxe, et de vocabulaire. VIII; MWF; 227F. MR. CONSTANS.

103-104-105.† FRENCH SYNTAX AND COMPOSITION. Special studies in characteristic problems of French syntax. V; F; 203F. MR. SIRICH.

115-116-117.† FRENCH LITERATURE: SEVENTEENTH CENTURY. Influence of the literary salons. Development of French prose. Perfection of French dramatic art by Corneille, Racine, and Molière. Reading, discussions, reports based upon collateral reading. III; TThS; 201F. MR. SEARLES.

118-119-120.† FRENCH LITERATURE: EIGHTEENTH CENTURY. Philosophic movement: Bayle, Fontenelle, Montesquieu, Voltaire, l'Encyclopédie, Rousseau. Literature: poetry, tragedy, comedy, novel. Reading, discussions, reports, based upon collateral reading. III; MWF; 110F. MR. PARKER.

121-122-123.† FRENCH LITERATURE: SIXTEENTH CENTURY. Forerunners of the Renaissance: Marot and l'Ecole Lyonnaise. The Renaissance movement and the reformation, Rabelais, Calvin and the Pléiade and its successors; Montaigne; the situation at the close of the century. (Not offered in 1922-23.) MR. SIRICH.

141-142-143.† REALISTIC NOVEL: NINETEENTH CENTURY. A study of realism with especial reference to the novel. Flaubert, Maupassant, Zola, etc. Alternates with 159-160-161. VII; TTh; 203F. MR. LeCOMPTE.

150-151-152.† FRENCH DRAMATIC LITERATURE. A study of the development of dramatic literature in France from the classical period to the present time. Alternates with 153-154-155. III; TTh; 203F. MR. OLMSTED.

¹ Absent on leave, 1922-23.

- 153-154-155.† FRENCH LYRIC POETRY. Principles of French prosody. A study of the evolution of French lyric poetry. Alternates with 150-151-152. (Not offered in 1922-23.) MR. OLMSTED.
- 159-160-161.† FRENCH CRITICISM. A study of the masters of French criticism. Alternates with 141-142-143. (Not offered in 1922-23.) MR. Lecompte.
- 171-172-173.† EXPLICATION DES TEXTES. An analytical and critical study of French texts, in which particular attention is given to style, thought, and diction. The course is conducted in French. (Not offered in 1922-23.)
- 174-175-176.† LECTURES IN FRENCH. *Le Roman français contemporain*. IX; TTh; 201F. MR. VAN ROOSBROECK.
- 191-192-193.† RESEARCH METHODS AND MATERIAL. MR. VAN ROOSBROECK.

SPANISH

- 100-101-102.† SPANISH ORAL DICTION. Oral dissertations on assigned subjects. Exercises in diction, syntax, and vocabulary. (Not offered in 1922-23.) MR. HERAS.
- 103-104-105.† SPANISH SYNTAX. Special studies in characteristic problems of Spanish syntax. VI; T; 230F. MR. OLMSTED.
- 115-116-117.† SPANISH LITERATURE: SEVENTEENTH CENTURY. Alternates with 156-157-158. IV; TS; 227F.
- 141-142-143.† SPANISH NOVEL. The development of Spanish fiction from the picaresque novel to that of the present day. (Not offered in 1922-23.)
- 150-151-152.† SPANISH DRAMATIC LITERATURE. A general survey of Spanish dramatic literature with especial attention to the Golden Age. (Not offered in 1922-23.)
- 156-157-158.† SPANISH LITERATURE: SIXTEENTH CENTURY. Alternates with 115-116-117. (Not offered in 1922-23.)
- 159-160-161.† CERVANTES. A study of his life and works. Attention will be centered upon *Don Quixote* and the *Novelas Exemplares*. (Not offered in 1922-23.)
- 174-175-176.† LECTURES IN SPANISH. Subjects to be announced. IX; TTh; 202F. MR. HERAS.

ITALIAN

- 159-160-161.† DANTE, PETRARCH, BOCCACCIO. An introduction to their works. The three cantiche of the *Divina Commedia* are read, one each year in rotation, together with a number of the canzoni, and sonnets of Petrarch, and portions of the *Decameron*. IV; MW; 213F. Miss PHELPS.

- 162f-163-164.† DANTE IN ENGLISH. Lectures; reading and discussion of the *New Life*, and two cantiche of the *Divine Comedy* not read in 159-160-161. Private reading of one other work. IV; F; 213F. MISS PHELPS.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201f-202w-203s. OLD FRENCH PHONOLOGY AND MORPHOLOGY. Lectures on the origin and development of the French language, with practical exercises and reports on assigned topics. Six credits. MR. Lecompte.
- 204f-205w-206s. READINGS IN OLD FRENCH LITERATURE. An introductory course in the reading of Old French. Different types of literature will be read and their origin and development discussed. A certain amount of collateral reading required. Three credits. MR. Lecompte.
- 207f-208w-209s. OLD PROVENÇAL. Reading in early provençal literature with special attention to the poetry of the troubadours. Six credits. MR. Lecompte.
- 222f-223w-224s. SEMINAR IN MODERN FRENCH LITERATURE. Six credits. VIII; IX; Th; 203F. MR. SEARLES.
- 241f-242w-243s. OLD SPANISH PHILOLOGY. Three credits. MR. GILLET.
- 244f-245w-246s. OLD SPANISH LITERATURE. Every year a different genre is studied, such as the epic. Subject to be decided by agreement of students. Three credits. MR. GILLET.
- 250f-251w-252s. SPANISH SEMINAR. Six credits. VIII, IX; F; 203F. MR. OLMSTED.
- 259f-260w-261s. RESEARCH IN ROMANCE LANGUAGES. Credit depends upon amount of work accomplished.

SCANDINAVIAN

Professors GISLE BOTHNE, ANDREW A. STOMBERG.

Prerequisites.—For major work, 18 credits; for minor work, 6 credits in the department. All required foreign language credits for the Master's degree in this department may be in either Norwegian, Swedish, or Danish.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f-102w-103s. MODERN NORWEGIAN LITERATURE. From 1814 to the present day. Prerequisites: Scandinavian 1-2 and 3-4. Nine credits. II; TThS. MR. BOTHNE.
- 104f-105w-106s. MODERN SCANDINAVIAN HISTORY. Knowledge of Scandinavian not required. Nine credits. IV; MWF. MR. STOMBERG.
- 107f-108w-109s. MODERN SWEDISH LITERATURE. The Swedish novel. Study of a selected list of Swedish classics. Nine credits. V; MWF. MR. STOMBERG.

- 117W-118S. EARLIER NORWEGIAN LITERATURE. Prerequisite: Scandinavian 102. Five credits. III; TS. MR. BOTHNE.
- 110W. IBSEN. Prerequisite: Scandinavian 101-102-103. Three credits. MR. BOTHNE.
- 114f. STRINDBERG. Prerequisite: Scandinavian 107f-108W-109S. Three credits. MR. STOMBERG.
- 131f-132W-133S. DANISH LITERATURE OF THE NINETEENTH CENTURY. From Oehlenschläger to the present time. Nine credits. MR. BOTHNE.
- 111f-112W-113S. OLD NORSE (ICELANDIC). Grammar and reading. Gunnlaug's Saga Ormstungu. Six credits. V; TTh. (Not offered in 1922-23.) MR. BOTHNE.
- 134f-135W. THE LANDSMAAL MOVEMENT AND LITERATURE. From Aasen to Garborg. (Not offered in 1922-23.) MR. BOTHNE.
- 136S. BJÖRNSON. A study of his activity as a central figure in modern Norway. MR. BOTHNE.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201-202-203. SEMINAR IN HISTORY OF SCANDINAVIAN LANGUAGES. MR. BOTHNE.
- 204-205-206. SEMINAR IN OLD NORSE. The Elder Edda. (Not offered in 1922-23.) MR. BOTHNE.
- 209-210. SEMINAR IN MODERN SWEDISH LANGUAGE AND LITERATURE. The course is based upon Schuck and Warburg's *Illustrated Svensk Litteraturhistoria* and includes a study of special authors. Nine credits. MR. STOMBERG.
- 215-216-217. SEMINAR IN NORWEGIAN LITERATURE. The various phases of the cultural development of modern Norway are discussed. The complete works of Björnson or Ibsen are especially studied. MR. BOTHNE.

SOCIOLOGY AND SOCIAL WORK

Professor LUTHER L. BERNARD; Associate Professor MANUEL C. ELMER; Assistant Professors ROSS L. FINNEY, GUSTAV A. LUNDQUIST; Special Lecturers FRANK J. BRUNO, OTTO W. DAVIS, WILLIAM W. HODSON.

Prerequisites.—For major work, 18 quarter credits; for minor work, 12 credits.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 100f. SOCIAL PSYCHOLOGY. Primarily for sociology students. The social attitudes; their development and modification under social pressures; the interactions of individuals and groups. II; TThS; 9F. MR. BERNARD.

- 101w. SOCIAL ORGANIZATION. The organization and structure of social groups; the selection of group types and values; the disorganization and reorganization of institutions; purposive social organization. II; TThS; 9F. MR. BERNARD.
- 102s. SOCIAL CONTROL. Nature, purpose, and methods of social control; institutional and non-institutional controls; the evolution of sanctions in social control; the revision of the social controls under the influence of modern science. II; TThS; 9F. MR. BERNARD.
103. SOCIOLOGY OF CONFLICT. (Not offered in 1922-23.)
104. STATE CARE OF DEPENDENTS, DEFECTIVES, AND DELINQUENTS IN MINNESOTA. (Not offered in 1922-23.) Specialists from the Board of Control and from institutions studied.
- 110w. METHODS OF COMMUNITY ORGANIZATION AND SOCIAL WORK IN SMALL TOWNS AND COUNTRY. Concrete problems and methods are emphasized. VIII, IX; Th; 9F. MR. LUNDQUIST.
- 114s. RURAL SOCIAL INSTITUTIONS. For advanced students. I; MWF; 105Ag. Eng. MR. LUNDQUIST.
- 119f. THE FAMILY. The evolution of the family; its various forms and their relation to other social institutions; the service of the family in social evolution; contemporary problems of the family (standards of living, birth rate, feminism, etc.). III; TThS; F9. MR. ELMER.
- 120f. SOCIAL PROGRESS. A study of the basis for social progress in human nature; analysis of fundamental social institutions with regard to their contributions to human advance; necessary social readjustments to convert drift into progress. II; MWF; F9. MR. BERNARD.
- 122w. METHODS OF SOCIAL INVESTIGATION. Methods of gathering and presenting community facts; social statistics; social surveys. Lectures, problems, and field work. VIII; MWF; F9. MR. ELMER.
- 123s. SOCIAL STATISTICS. A study and analysis of social statistics and their bearing upon group life. Especially designed to give social workers and public health officials the training necessary to carry on their work successfully. VIII; MWF; F9. MR. ELMER.
- 125-126-127. SETTLEMENT AND COMMUNITY CENTER WORK. (Not offered in 1922-23.)
- 128s. CHARITABLE ADMINISTRATION, FINANCE, AND PUBLICITY. A technical study of methods of organizing charitable agencies, of financing them, and of making the public aware of their work. Lectures and practice work. VIII, IX; Th; F9. MR. DAVIS.
- 130s. ADVANCED SOCIAL CASE WORK. An intensive study of social case work as the basis of practical dealing with problems of dependency and defectiveness. Lectures and conferences. VIII, IX; T; F9. MR. BRUNO.

- 132s. JUVENILE COURTS AND PROBATION. (Not offered in 1922-23.)
- 133f. MEDICAL SOCIAL SERVICE. A course open only to students who are properly grounded in case work and who wish to specialize in this field. IX and ar; WF and ar; F9. DR. BRANNICK.
- 134s. LEGAL PROTECTION OF THE CHILD. A study of the relation of law to child welfare. A survey of existing children's protective legislation, of its administration and its future development. IX; MWF; F9. MR. HODSON.
- 135s. FIELD PRACTICE IN LEGAL PROTECTION OF THE CHILD. Designed to meet the individual needs of students taking 134. Ar. Ar.
- 138w-139s. MENTAL CASE WORK. A study of mental abnormality and its treatment through case work. Lectures and clinical instruction. IX; Th and ar; F5. MISS SEEBERG.
- 140w. HISTORY OF SOCIAL THEORY. From the time of the Greeks, with special reference to the more recent development of sociology. The theories are related to their social backgrounds. II; MWF; F9. MR. BERNARD.
- 141s. CONTEMPORARY SOCIAL THEORY. An intensive study of developments in the social theory of the late nineteenth and the twentieth centuries. II; MWF; F9. MR. BERNARD.
- 150f. SOCIAL MOVEMENTS. Subjects for fall quarter: the literature of social protest. Open to qualified students in either English or sociology. (Not offered in 1922-23.)
- 151w. LABOR PROBLEMS. Subject for winter quarter: social aspect of the labor problem. (Not offered in 1922-23.)
- 152s. INSTITUTIONAL ADMINISTRATION. Subject for spring quarter: problems of institutional administration and reconstruction. (Not offered in 1922-23.)
- 180f-181w-182s. SEMINAR IN EDUCATIONAL SOCIOLOGY. IX, X; M; Ed. MR. FINNEY.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 204f-205w-206s. SEMINAR IN SOCIAL THEORY. MR. BERNARD.
- 221f-222w-223s. GRADUATE FIELD TRAINING. Twelve hours per week each semester.
253. CRIMINOLOGY. An intensive analysis of recent literature on the nature of the criminal, causes of crime, and methods of treatment and prevention. (Not offered in 1922-23.)

SOILS

Professor FREDERICK J. ALWAY; Assistant Professor CLAYTON O. ROST.

Prerequisites.—For major work, at least two years of work in chemistry, including both quantitative analysis and organic chemistry, and one year of work in general physics. Those students who have not had courses in the elements of geology and mineralogy will be expected to take Geology 1 and 21 during the first year of graduate work. A reading knowledge of French and German is required for the Master's degree. In certain cases where some other modern foreign language would be more valuable in connection with the thesis it may be substituted.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

- 101f. CHEMICAL ANALYSIS OF SOILS. A laboratory course on the chemical examination of soils, including both fusion and extraction methods for mineral nutrients. Prerequisites: Soils 4 and 5 and quantitative analysis. Five credits. 1:30-5:20; MWF; 156Ch. MR. ROST.
- 102f,w,s. SPECIAL PROBLEMS IN SOILS. Individual laboratory or field work upon some special soil problem in soil physics, soil chemistry, or soil management. Arrangements must be made in advance. Prerequisites: Soils 4, 5, 101, and 108. Three to 5 credits, according to work. 156Ch. MR. ALWAY, MR. ROST.
- 104s. SOIL-SURVEYING. Field practice in surveying soils and the preparation of soil maps. Prerequisites: Soils 4, 5, and 108. Three credits. MR. McMILLER.
- 105w. MINNESOTA SOILS. Detailed study of the soils of Minnesota. Origin, formation, and classification; physical and chemical characteristics; moisture relations; response to manures, fertilizers, and soil amendments; naturally unproductive types and their reclamation. Lectures and laboratory. Prerequisites: Soils 4 and 5. Three credits. III; TThS; 251Ch. MR. ALWAY.
- 106w. PEAT SOILS. Formation, chemical composition, physical properties, classification, and reclamation. Lectures, laboratory, and greenhouse work. Prerequisites: Soils 4 and 5. Two credits. III; WF; 251Ch. (Not offered in 1922-23.) MR. ALWAY.
- 107w. FERTILIZERS AND MANURES. Sources, composition, and uses of the various fertilizers, manures, and soil amendments. Lectures and laboratory work. Prerequisites: Soils 4 and 5. Two credits. IV; TS; 251Ch. MR. ROST.
- 108w. PHYSICAL PROPERTIES OF SOILS. A laboratory course on the determination of physical constants of soils, including mechanical composition, moisture equivalent, and hygroscopic coefficient. Prerequisites: Soils 4 and 5. Three credits. 1:30-5:20. TTh; 156Ch. MR. McMILLER.

COURSES PRIMARILY FOR GRADUATE STUDENTS

- 201w. CLASSIFICATION OF SOILS. Study of the various systems of classification which have been proposed. Individual work, with assigned readings and conferences. Open only to those graduates who have a reading acquaintance with French and German. Prerequisites: Soils 4, 5, 101, and 108. Three credits. Mr. ALWAY.
- 202f,w,s. RESEARCH IN SOILS. The investigation in the field, in the laboratory, or in both, of soil problems. The particular problem which a student may select will depend upon his previous training in agronomy, botany, chemistry, geology, and physics. Credit, according to work. Mr. ALWAY.
- 203w. SEMINAR IN SOILS. Review of current literature; presentation and discussion of papers on research; study of methods of investigation of soils. Required of graduate students. No credit. VII; T; 251Ch. Mr. ALWAY.

SURGERY

(Including divisions of General Surgery, Experimental Surgery, Orthopedic Surgery, Urology, and Dental Surgery.)

For staff and courses of study offered, see special bulletin of graduate work in medicine.

VETERINARY MEDICINE

Professors CLIFFORD P. FITCH, MYRON H. REYNOLDS.

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